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**US Army Corps  
of Engineers®**

**FINAL**

# **Geographic Information System (GIS) System Architecture and Design Report**

Submitted to:  
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# 1 Purpose

System architecture design is a process to promote successful Geographic Information System (GIS) implementation through the recommendation of hardware, software, and network solutions that are based upon existing and future operational workflow requirements and associated hardware specifications.

This document provides the GIS system architecture and design for the Planning Division of the U.S. Army Corps of Engineers (Corps), Los Angeles District. This design specifically supports the identified requirements of the California Coastal Sediment Master Plan project, while allowing for integration with, and support of, an envisioned department and district-wide GIS solution. A variety of technologies need to support trained staff following proper procedures to support the effective use of GIS. This plan will (1) summarize project requirements; (2) recommend a system architecture, and (3) provide an implementation strategy.

# 2 Project Overview

The National Regional Sediment Management Program (RSM) was implemented to develop methodologies and protocols to address and abate site-specific shoreline erosion problems at regional scales. The Los Angeles District, Planning Division is leading the California component of the National RSM Program, called The California Coastal Sediment Master Plan (Master Plan). The Master Plan initiative has been designed as a collaborative effort between federal, state, and local agencies and non-governmental organizations to study California's coastal sediment management needs on a regional, system-wide basis.

In support of this study, the Master Plan will require the collection, management and analysis of geospatial information from various sources and scales into a central GIS database repository that can be shared among various stakeholders. Initially, small-scale data in support of the project is being collected along the California coastline and large-scale data for Ventura County. The GIS database will allow for quick and comprehensive analysis of disparate data types such as coastal wetlands, submarine canyons, transportation facilities, dams and debris basins, littoral cells, and other pertinent sediment-related information. The voluminous amount of data required to perform system-wide to project-specific analyses along the entire coastline of California requires a planned hardware, software, and networking approach through the design of a comprehensive system architecture plan.

## CALIFORNIA COASTAL SEDIMENT MASTER PLAN GIS STUDY AREA



Parsons Brinckerhoff, Nov. 13, 2003

### **3 Project GIS Requirements Summary**

Provisions for a detailed GIS requirements document are not planned to support this system architecture design. In its place, this section will provide a cursory review of the GIS user needs for the Coastal Studies Group, Planning Division. Several meetings with Corps staff along with a GIS User Need Survey (Appendix A) provided the necessary information for this section.

#### **3.1 Existing Conditions**

The Los Angeles District has been employing GIS technology for many years on infrastructure projects in four of the six divisions: Planning, Engineering, Construction-Ops, and Real Estate. This technology has been used as a support function for larger Corps projects that require GIS for spatial analysis. Each of the divisions has varying levels of GIS expertise and trained staff resources, though for most, GIS is not their primary function or area of expertise.

Within the District, geospatial data management activities do not receive a high priority. This is typical of most Corps districts, where spatial analysis is performed in a largely uncoordinated fashion that results in duplication of data, lack of a general knowledge base of Corps geospatial resources, and little emphasis in the application of Corps geospatial standards. The lack of a coordinated GIS program for the District has inhibited the maturity of the GIS environment from an end user application to becoming an enterprise-wide solution. As a result, a stovepipe GIS environment has emerged where each department develops and manages their respective GIS computational and staff resources.

##### **3.1.1 Staff**

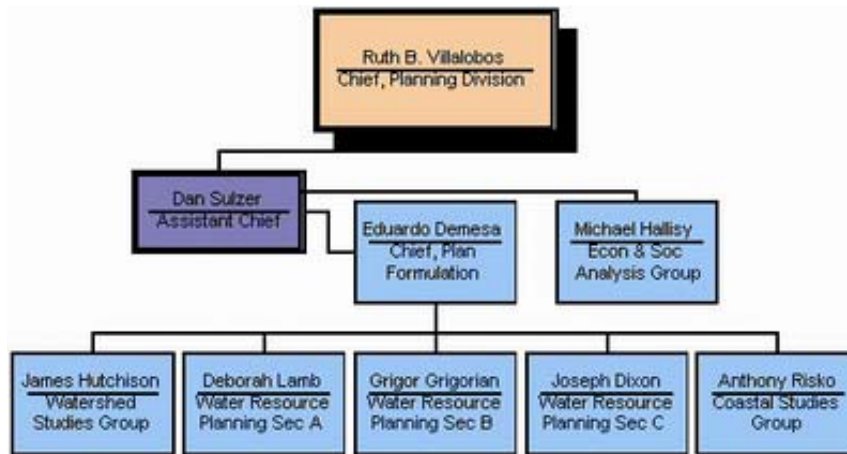
Having qualified staff with the necessary experience in developing and maintaining GIS resources is an important consideration when selecting an appropriate system design. In addition to technically skilled GIS staff, other supporting personnel will be needed to install and maintain the software, hardware and network environment.

Within the District there is an informal fifteen-member Geospatial Data & Systems Technical Committee, with members from the various divisions that meet regularly to discuss the general planning of GIS resources and technical issues for the District. Regrettably, the Committee does not have an allocated funding budget to direct geospatial initiatives for the LA District such as the purchasing of new hardware and software. The Committee is directed by Joe Evelyn, Chief of the H&H Branch.

There are two full-time GIS Analysts that provide GIS services to the Planning Division, both of whom report to Anthony Risko from the Coastal Studies Group. The Division incorporates a staff of approximately 100 people that support planning studies within the Los Angeles District in the areas of Flood Control, Navigation, Shore Protection,

Environmental Restoration, and Recreation. The staff encompasses Archaeologists, Civil Engineers, Ecologists, Economists, Landscape Architects, and Biological, Environmental, and Physical and Social Sciences Study Managers. An organization chart is shown in Figure 1.

**Figure 1 – Planning Division Organization Chart**



### 3.1.2 GIS Functions

GIS use in the Division is project-based with data acquisition and use centered on short-term requirements. This is typical of most department based GIS environments where a few GIS specialists support projects on a single workstation environment. Data are shared via the local area network (LAN), though GIS project data are stored only on local computers. Standard GIS functions include data development, overlay analysis, mapping, and file conversion.

Numerous adhoc map products are produced to support report production, public outreach, and internal planning purposes. Data creation is primarily based on editing and recompiling source files received from other public agencies. Data are also provided by other supporting departments on a site-specific basis, and created through field data collection using GPS or other location reference methods.

Review of existing work flow procedures show that data documentation and metadata creation are not being performed to Corps data standards. In addition, there are no procedures in place to securely back up and store offsite GIS project related information, since all work is performed on personal computers and not on central servers. GIS project files can easily be greater than the capacity of locally burning CDs and DVDs and should be stored on central data servers and sent offsite for data protection and archiving.

### **3.1.3 Systems and Network Environment**

The Los Angeles District's Information Management Office (IMO) serves as an administrative and advisory staff office, exercising principal staff actions, planning, and policies relating to Information Management. IMO provides Information Technology planning & acquisition support for the Los Angeles District; hardware and software support for the computer users; and system administration for the Local Area Network. This entails service to over 800 personnel located throughout the primary building at 911 Wilshire, floors nine through fifteen, and twenty remote offices (18 offices have T1 Frame Relay Link to the District DS3). The standard operating system is Microsoft Windows NT4/2000 running over a TCP/IP 1G Ethernet LAN. Appendix B shows a diagram of the LAN and WAN for the Los Angeles District.

A speed test (<http://bandwidthplace.com/speedtest/>) was performed on 11-04-2003 at 2:30PM PST on MaLisa Martin's desktop computer to verify the actual response time to the Internet. The results of the speed test determined a very slow 112 kilobits per second (kpbs) connection, which is only twice the speed of a 56 kbps dial-up. On a relative scale, a typical DSL speed starts at 300 kbps and a full T-1 maximum speed is 1.54 Mbits per second. The slow connection to the Internet hinders the downloading of information from data repositories and sharing of spatial data to outside partners via FTP or from a future ArcIMS map server.

#### ***Information Management Office***

The IMO coordinates procurement, installation and maintenance of all information technology in the district. GIS software and hardware are procured, installed, and maintained exclusively by IMO staff. Systems and services provided by IMO include the following:

- Network Operations and Administration
- Telephone Systems Administration
- Server Systems Administration
- Help Desk Customer Support
- Technical Information Processing (TIP)
- Geographic Information Systems (GIS) Support
- Computer Aided Design and Drafting (CADD) Support
- E-Mail Administration
- Computer Systems Security
- Internet Site Development/Administration
- IM Project Planning/Implementation
- Records Management
- E-Library Gateway
- District IT Strategic Plan

### ***District-wide GIS***

The Los Angeles District's GIS configuration includes networked PC-based workstations with stand alone licenses and a central concurrent license server running ESRI GIS software - ArcInfo, ArcView 3.x, and ArcGIS 8.x. The following table lists the type and number of shared and stand alone licenses that are available to the Coastal Group's GIS staff.

**Figure 2 - GIS User Requirements Summary**

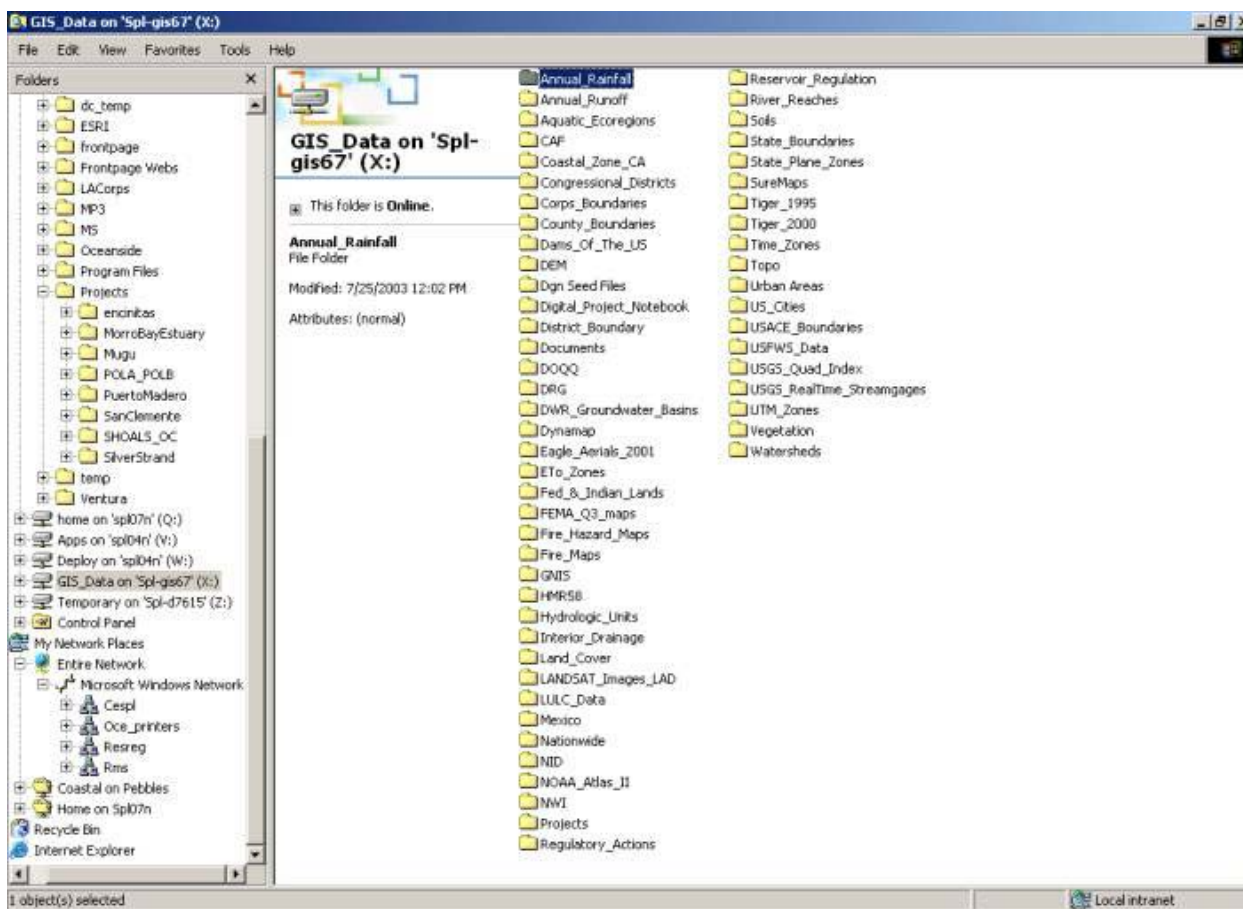
<b>ESRI Software Licenses</b>	<b>Stand Alone (Coastal Group)</b>	<b>Concurrent (District)</b>
<b>ArcView 8.2</b>	3	15
<b>ArcInfo 8.2</b>		3
<b>ArcEditor 8.2</b>		1
<b>Spatial Analyst</b>		15
<b>3D Analyst</b>		15
<b>ArcPress</b>		6
<b>Geostatistical Analyst</b>		1
<b>StreetMap USA</b>		1
<b>ArcView 3.2</b>	3	

A GIS file server is located within the Hydrology & Hydraulics Branch (H&H) and is used primarily as a data repository. The connection to the H&H GIS server is typically known as the "X" drive on the LAN.

The H&H GIS server consists of a Dell PowerEdge 6400, Single Processor 700MHz/1M Cache, PIIIX, 2GB RAM, 8x36GB (RAID 5 configuration) Ultra SCSI HardDrive (232GB useable, out of which 124GB is free (53%)). There is a broad range of valuable data that has been acquired over the years and stored on the X drive. Data on the X drive is rarely used outside of H&H due to the lack of knowledge about the accuracy, source, and datedness of the information. This includes: FEMA floodplains, USGS digital elevation models, FWS wetlands, etc. – see Figure 3.

The data that resides on the H&H GIS server are backed up to an adjacent server in the same location. It is highly recommended that procedures be implemented to backup and secure this information to an off-site facility.





**Figure 3 – H&H GIS Server**

### ***Coastal Studies Group***

The Coastal Studies Group's GIS resources include networked workstations and laptops that are used to store and analyze GIS project data locally using ArcView 3.x and ArcGIS. In addition, the Coastal Studies Group has access to the Planning Division's now defunct GIS lab that contains a UNIX workstation and other ancillary equipment. It is envisioned that the GIS lab will be modernized and host future GIS activities for the Planning Division. The GIS staff currently has access and utilizes the following equipment:

- 2 – Dell Workstation PWS 330 Intel Pentium 1400 MHz, 1GB RAM, 70GB HD
- 1 – HP DesignJet 800 PS Plotter with 160MB RAM, 6 GB Hard drive
- 2 – HP LaserJet 1200 Series Printers
- 1 – Calcomp Drawing Board III Digitizer – not being used
- 1 – Sun Sparc 20 UNIX Workstation – not being used
- 1 – HP ScanJet 4C 8.5x14" Flatbed Scanner – not being used

## 3.2 Project Requirements

Interviews with the GIS staff from the Coastal Studies Group have identified existing and future user requirements for the Planning Division. As shown in Figure 4, the number of professional GIS users will increase from two to five over the next two years. As awareness of GIS technology grows within the Planning Division, the number of casual GIS users with ArcGIS ArcView on their desktop will also increase for a total of twenty ArcGIS users. It should be noted that ArcGIS ArcInfo and ArcGIS ArcView are built upon the same technology and have very similar system requirements. All GIS users will be migrating from ArcView 3.2 to the new ArcGIS platform during this time period.

**Figure 4 - GIS User Requirements Summary**

Year	Total Users	Professional Users	Casual Users		Map Req/Hr
		ArcGIS ArcInfo	ArcGIS ArcView	ArcView 3.x	
2004	2	2	2	2	0
2005	10	3	7	2	0
2006	20	5	15	0	100

In the future, it is anticipated that some of the GIS data residing on the Planning GIS server will be distributed through an ArcIMS map server as hourly map requests via a web browser. The users of this information includes: Corps staff, stakeholders of the project, other agencies, and the public. Having this data available on the Intranet and/or Internet will increase awareness of the project and provide the mechanism to disseminate the information in a timely and efficient manner to hundreds or even thousands of users.

### 3.2.1 GIS Data

The project has initiated a significant GIS data gathering task that will be used to analyze and evaluate the sediment movement and replenishment needs of The California Statewide Sediment Master Plan. PB led the data collection effort with the assistance of the University of Southern California (USC) in performing a data source search and compiling readily available GIS information. This initial data search will help the Corps understand what datasets are already available, so as not to duplicate the efforts of other organizations. In addition, the collection of those datasets will provide an estimate of the level of data to be collected for the entire project, and thereby more effectively designing the system architecture to meet those data needs.

Two levels of data were collected: the planning level (statewide) and the macro level (Ventura County coastline). Statewide data were collected for a study area that includes all major hydrologic units (watersheds) that border the Pacific Ocean. Ventura County was chosen by the Corps as a test county for collecting more detailed data types.

Planning Level datasets collected by PB include:

- Roadways (for 20-ton trucks)
- Railways
- Submarine Canyons
- Navigation Structures
- Coastal Wetlands

Planning Level datasets collected by USC include:

- Counties
- Public Beaches
- Erosion Hot Spots
- Watershed Boundaries
- Congressional Districts
- Dams
- Debris Basins
- Littoral Cells

Macro Level datasets collected by PB include:

- Shoreline Stabilization Structures
- Coastal Wetlands – Vegetation
- Grain Sizes

Macro Level datasets collected by USC include:

- Controlled Aerial Imagery
- U.S. Geological Survey Digital Elevation Models (DEM) and Digital Terrain Models (DTM)
- Land Use/Land Cover

The datasets collected were ESRI standard GIS file types (ArcView 3.x, ArcGIS, etc.) including shapefiles (point, polyline, polygon), rasters (GRID) and coverages (ArcInfo). The datasets remain in their native format, including their original projections. The exceptions are the Digital Elevation Model (DEM) files which were converted to GRID format for use with ArcView and ArcGIS.

The data collection effort resulted in a compilation of almost 2,500 files with a cumulative size of approximately 14.5 Gigabytes (GB), out of which 13.3 GB are from the USGS digital Ortho Quads in TIFF format for the Ventura County study limits. Imagery compression software using wavelet based technology such as LizardTech's MrSID or ER Mapper's ECW is recommended and can provide dramatic file size reduction of up to 95 percent, while maintaining the original image integrity. It is estimated that the final project build-out for data storage needs will be close to 250 Gigabytes without image data compression. This does not include files created for project analysis tasks that could double the storage requirements to over 500 GB during the next three years.

A summary of Parsons Brinckerhoff's data collection efforts is attached as Appendix C along with a data collection summary table. The table summarizes data sources, coverages and gaps, data quality, size and type, and other characteristics.

### **3.2.2 GIS Workflow Processes**

GIS staff will be providing comprehensive services for project development including spatial analysis, cartographic production, data conversion, and data distribution to project partners.

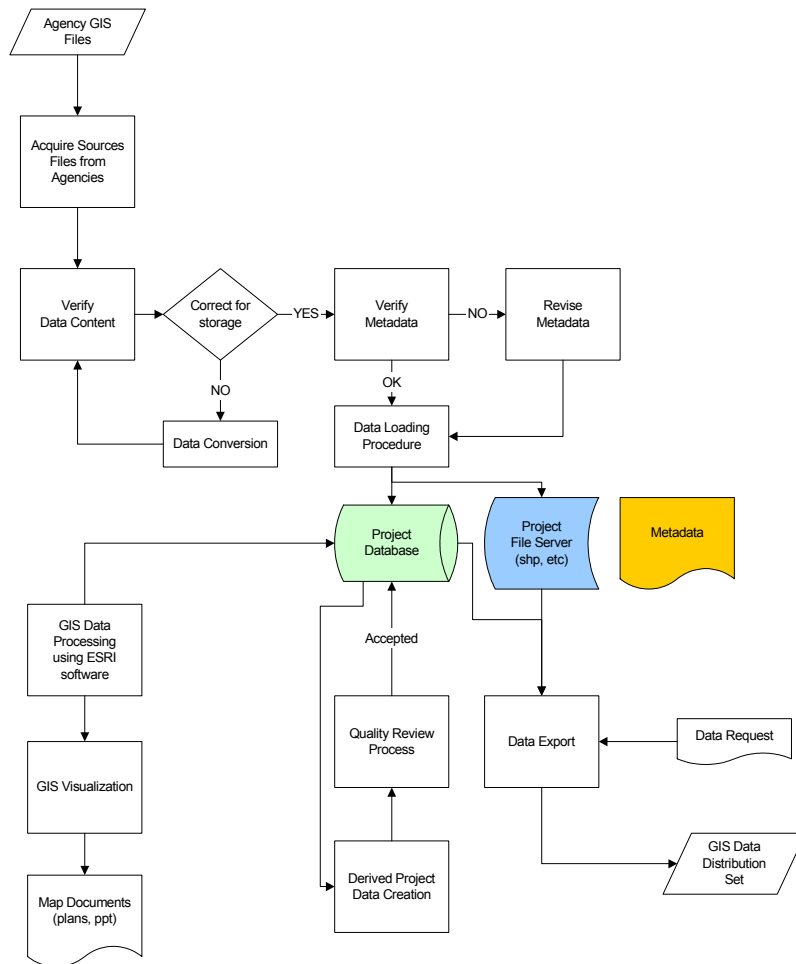
Out-of-the-box software functionality is anticipated to support the majority of user requirements within the ArcGIS technology, with few if any special GIS applications or extensions used. The use of ArcView 3.x desktop software will continue for discrete tasks that are more effectively done in this software.

The immense volume of data necessary for this project will require special consideration for data handling methods to ensure a productive work environment. This may include data structure (shapefile vs. geodatabase) and transfer (DVD vs. FTP), batch processing, and print production (capability to print large format maps with aerial imagery).

Other important issues to consider for this project may include:

- Data distribution to project partners and other agencies
- Processes for incorporating GIS data updates
- Implementation of Corps' geospatial data standards
- Staff training and additional support needs
- Metadata and data archiving procedures

The modeling of project data requirements will allow the GIS team to visualize the work flow processes necessary to provide the most efficient solutions for the project. The following diagram shows an example of a possible modeled work flow process for the project.



**Figure 5 – Work Flow Process Example**

### **3.2.3 Data Standards**

Data standardization will enable data that are collected to be shared among the project stakeholders and will extend their usefulness to other future Corps projects. Strict compliance with mandated standards will also assure that the sharing of geospatial information will be compatible and interchangeable among various private, state, local, national, and international organizations and agencies.

#### ***GIS Standards***

The CADD/GIS Center for Facilities Infrastructure and Environment has developed a database schema called the Spatial Data Standards for Facilities Infrastructure and the Environment (SDSFIE) that defines the data content standards within the USACE. More information on this standard can be found at <http://www.upper-90.com/tssds.htm> or contact the SDSFIE Project Manager Nancy Towne at [Nancy.A.Towne@erdc.usace.army.mil](mailto:Nancy.A.Towne@erdc.usace.army.mil).

The USACE requires the use of North American Datum (NAD) 1983 or World Geodetic System (WGS) 1984 horizontal datums. GIS data should be created to meet the Federal Geographic Data Committee Standard Geospatial Positioning Accuracy Standards and the following USACE standards and specifications:

- ER 1110-1-8156, Policies, Guidance, and Requirements for Geospatial Data and Systems, 01 August 1996.
- EM 1110-1-1000, Photogrammetric Mapping, 01 July 2002
- EM 1110-1-2909, Geospatial Data and Systems, 01 July 1998
- EM 1110-1-1005, Topographic Surveying, 31 August 1994
- A-E CADD/GIS Deliverables Standards @ <https://tsc.wes.army.mil/products/standards/aeguide/index.asp>

#### ***FGDC Metadata***

All GIS data (primary and secondary sources) are required to be documented to describe the content, quality, condition, and other characteristics in accordance with the Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata <http://www.fgdc.gov/metadata/contstan.html>.

#### ***Data Sharing***

In accordance with Executive Order 12906, April 13, 1994 all geospatial information will be documented (metadata) and shared to the extent permitted by law to avoid wasteful duplication of effort and promote effective and economical management of resources by Federal, State, local, and tribal governments.

### 3.3 GIS Software Review

The USACE is supported by ESRI commercial software technology. The ArcGIS software suite provides scalable GIS solutions from small applications for the individual user to extensive multiuser enterprise-wide systems. As shown in Figure 6, ArcGIS consists of ArcView, ArcEditor, and ArcInfo for the desktop, and ArcIMS and ArcSDE for enterprise solutions.

#### 3.3.1 ArcGIS Desktop

ArcGIS desktop applications include ArcInfo, ArcEditor, ArcView, and ArcReader and are based upon Microsoft's common object model (COM) programming technology. ArcGIS is supported on the Windows NT/2000/XP platforms and Windows 2000 Terminal Servers.

##### **ArcReader**

ArcReader files provide an effective means for non-GIS project participants to view and query informative maps. ArcReader files are created using the ArcGIS Publisher extension.

##### **ArcView**

ArcView 8.x improves upon the functionality of world's leading GIS software ArcView 3.x, and adds features for managing data, projection on-the-fly, metadata, annotation, and includes Microsoft Visual Basic for Applications (VBA).

##### **ArcEditor**

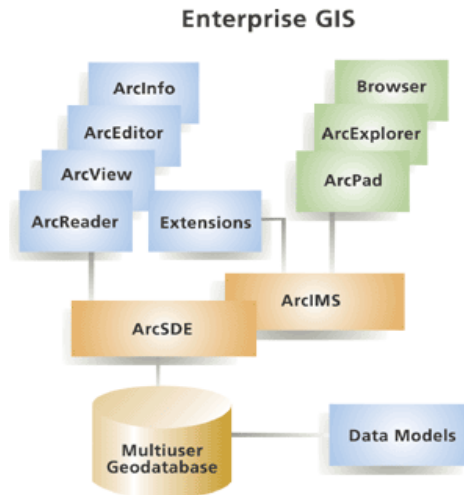
ArcEditor has all of the functionality of ArcView plus the ability to edit and create features in shapefiles, personal geodatabases, and multiuser geodatabases.

##### **ArcInfo**

ArcInfo is the most comprehensive professional desktop GIS solution provided by ESRI and includes all of the functionality of ArcEditor and ArcView products plus a complete set of advanced data management, analysis, and conversion tools.

#### 3.3.2 ArcGIS Enterprise

ESRI provides several GIS applications that allows an organization to leverage their existing GIS data and distribute it throughout an enterprise-wide environment. This technology includes ArcSDE and ArcIMS.



**Figure 6 – ESRI Enterprise GIS**

**Source: ESRI**

### **ArcSDE**

ArcSDE allows the storage and management of spatial data in a database management system such as Oracle, Microsoft SQL Server, Informix, and IBM DB2. Using the speed and efficiency of a relational database model, ArcSDE serves spatial data to the ArcGIS desktop and ArcIMS applications and provides the ability to manage multiple users editing the same spatial database with long transactions, alternate versions, and history. An ArcSDE CAD client API is available to support AutoCAD and Microstation CAD clients.

### **ArcIMS**

ArcIMS is ESRI's solution for distributing GIS information on the Web, either within an organization's Intranet or sharing spatial data over the Internet. ArcIMS provides an out-of-the-box solution for authoring and publishing maps that is based upon a highly scalable architecture and can support many concurrent users.

### **3.3.3 ArcGIS 9.0**

In the spring of 2004, ESRI will release ArcGIS 9.0 as the next major version of the ArcGIS system. Version 9.0 will extend the current platform with new features and capabilities in the areas of geoprocessing, 3D visualization, annotation and labeling, along with server-based GIS.

ArcGIS Server is a GIS enterprise application server that provides complete GIS functions that are typically found on the desktop, but will integrate serverside GIS applications with the larger IT environment.

ArcGIS 9.0 will also include enhancements to raster storage, management, query, and visualization. The improvements will become more apparent for users of large datasets and will be fully integrated into the geodatabase format.



## 4 System Architecture Design

System architecture design facilitates in the selection of hardware and software solutions based upon the operational and system needs of the GIS users. It is also important to leverage the existing investment in IT infrastructure and staff in the selection of a particular design solution that best fits the organization.

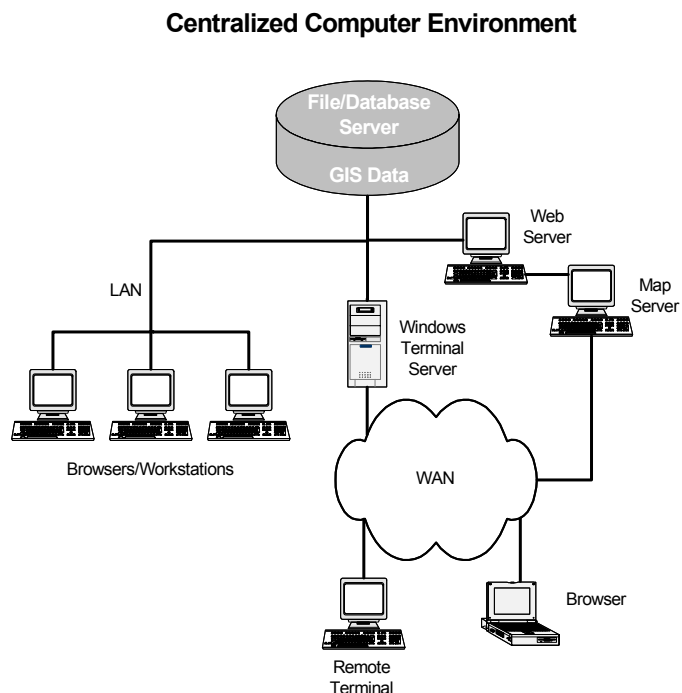
### 4.1 System Configuration Alternatives

Various system configurations exist and GIS technology is scalable to meet most architecture environments. The typical system architecture can fall into two standard configurations, centralized and distributed. A centralized configuration is one central GIS server that supports GIS file and database transactions, whereas a distributed GIS server employs data replication to support a multi-department environment. Both configurations can be deployed to support user requirements within the typical network environment, but a centralized alternative simplifies data and hardware maintenance and reduces overall administration costs.

#### 4.1.1 Centralized GIS Architecture

Figure 7 shows a centralized GIS architecture that includes a central GIS data server supporting GIS activities over a local area network (LAN) and wide area network (WAN). ESRI suggests avoiding

client access to remote file and database servers over WAN connections due to an increased load on the network, which can result in a degraded network performance. Remote users that require access to the GIS data server should use a Citrix MetaFrame terminal client from a Microsoft Windows Terminal Server. Web users would access the data from the central GIS server from a web and ArcIMS map server. A centralized data server has several benefits for the small to medium sized organization including: reduced hardware and administration costs, improved data access and security, and reduced network traffic.



**Figure 7**

#### 4.1.2 Distributed GIS Architecture

A distributed GIS architecture is shown in Figure 8 where multiple GIS data servers support several grouped clients over the LAN, such as a multi-departmental environment. As the system becomes more distributed it becomes more expensive and difficult to maintain due to replication of data to each of the data sites. This alternative results in increased network traffic, higher hardware costs, and disconnected operations. Overall, the distributed configuration has higher maintenance costs than a centralized architecture and is typically not recommended for small to medium sized organizations.

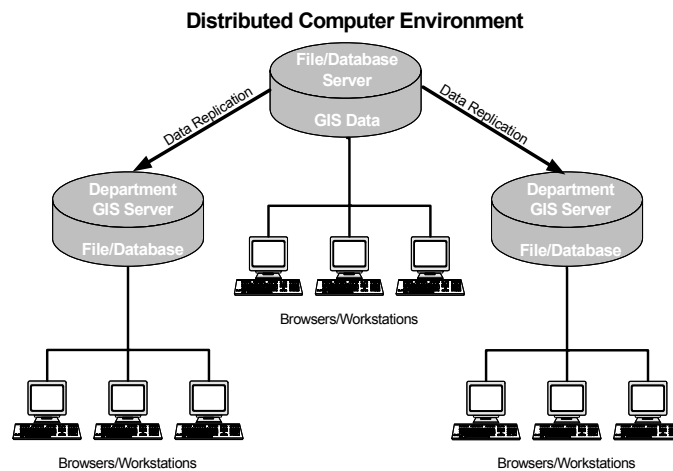


Figure 8

#### 4.1.3 Recommended GIS Architecture

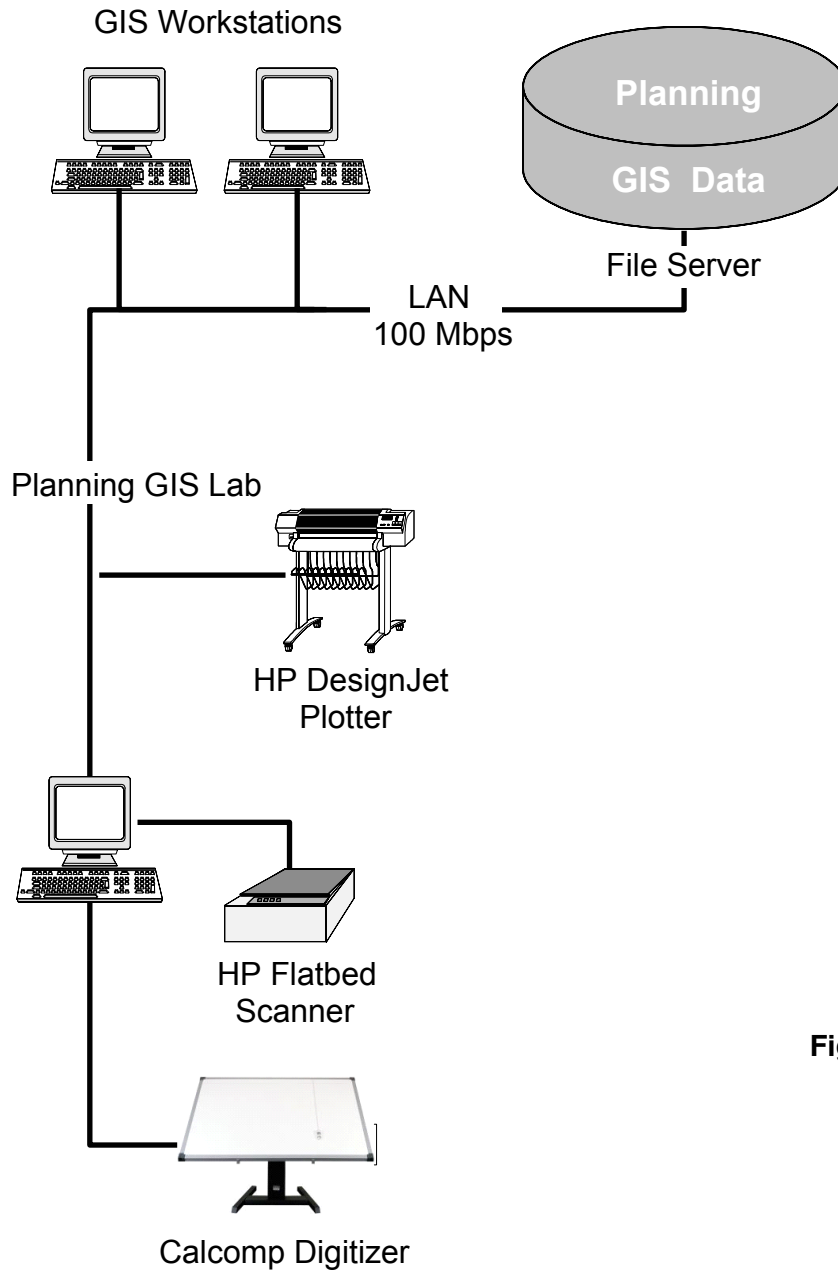
It is recommended that the Planning Division follow a computer configuration that is based upon a central GIS data repository. Initially, the repository would be loaded with the GIS project data and be accessed as a typical file server over the LAN, as shown in Figure 9. Users would access the data from their existing GIS computers and the workstation in the GIS Lab. All GIS project related data should reside on the GIS data server, while local data storage on individual computer hard drives should be discouraged. This change in work flow will increase project coordination among team members, reduce data redundancy, and ensure security with IMO providing nightly backups and offsite storage.

In 2005, an ArcSDE-Oracle server will be implemented and will increase the speed from the client user to accessing the voluminous amount of data on the server, Figure 10. ArcSDE-Oracle server works with ArcGIS and ArcIMS technology and provides performance enhancements over the file server through efficient storage methods within a relational database. Once ArcSDE-Oracle server is implemented, the number of clients running ArcGIS can be increased from twenty to fifty casual GIS users.

Figure 11, shows an expanded architecture environment for YR 2006 that includes an ArcIMS map server. ArcIMS provides the mechanism to distribute GIS information to

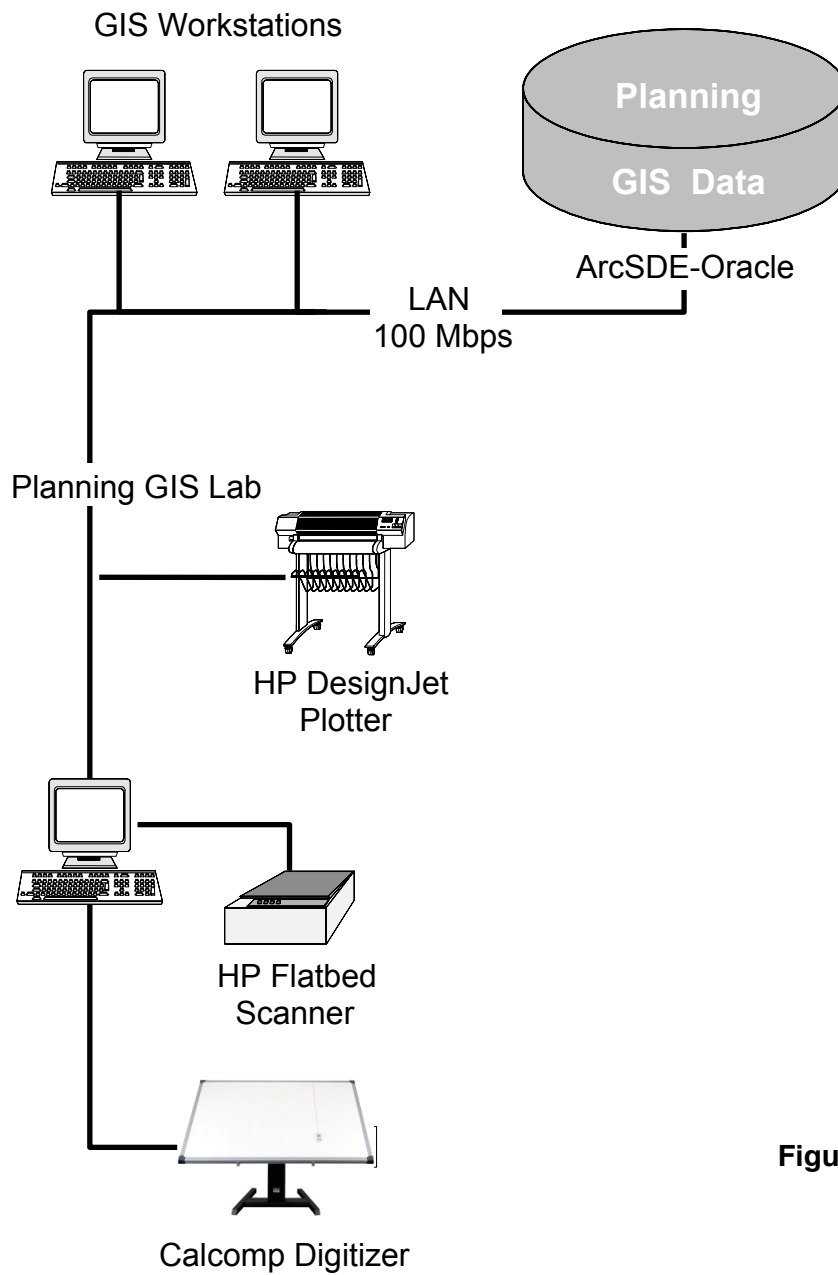
hundreds of casual users from within the Los Angeles District's Intranet or thousands of people over the Internet. The recommended integrated ArcIMS/ArcSDE/Oracle solution for the Central GIS repository is a powerful, and scalable web GIS environment.

## Planning GIS Environment YR 2004



**Figure 9**

## Planning GIS Environment YR 2005



**Figure 10**

## Planning GIS Environment YR 2006

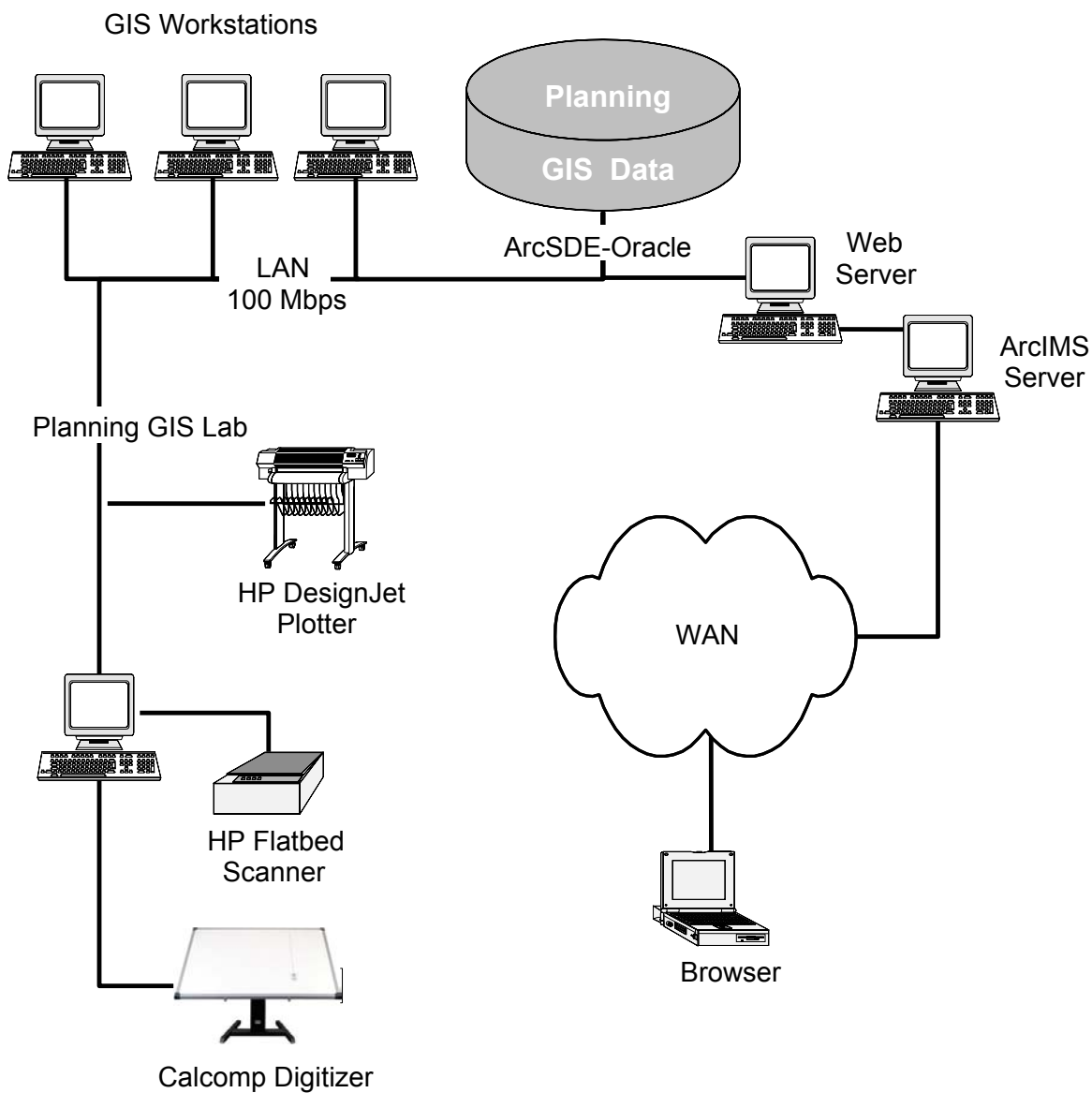


Figure 11

## 4.2 Platform Sizing

Platform sizing is based upon ESRI's system configuration sizing models that are backed by laboratory testing in Redlands, CA. Figure 12 shows the load requirements for each of the server platforms for the next three years that were derived from the GIS User Need Survey. Users are classified by ArcGIS and ArcView 3.x desktop clients and ArcIMS web services clients. In this centralized configuration, we've selected a file server that will be upgraded to an ArcSDE-Oracle server in YR 2005 and an additional ArcIMS web server in the following year. The initial load will be two peak users in YR 2004 and then increasing to twenty peak users in YR 2006.

Figure 12 - GIS User Load Summary

	YR 2004				YR 2005				YR 2006			
Server Platform	Total Users	ArcGIS	ArcView 3.2	ArcIMS Req/Hr	Total Users	ArcGIS	ArcView 3.2	ArcIMS Req/Hr	Total Users	ArcGIS	ArcView 3.2	ArcIMS Req/Hr
		Peak Loads				Peak Loads				Peak Loads		
File Server	2	2	1	-	3	2	1	-	5	4	-	-
ArcSDE Geodatabase	-	-	-	-	10	4	-	-	20	16	-	100
<b>Total</b>	<b>2</b>	<b>2</b>	<b>1</b>		<b>13</b>	<b>6</b>	<b>1</b>		<b>25</b>	<b>20</b>		<b>100</b>

## 4.3 Network Requirements

The following chart provides an overview of the ESRI-recommended network design guidelines and shows that the Corps' 100-Mbps LAN provides the capacity for 20-40 file-based clients or 100-200 ArcSDE clients, assuming an optimistic existing network load.

Source: ESRI

Local Area Networks Bandwidth	Concurrent Client Loads				
	File Servers	SDE Servers	X Emulation	Windows Terminals	Web Products
10 Mbps LAN	2-4	10-20	50-75	350-700	150-300
16 Mbps LAN	3-6	16-32	80-120	550-1100	250-500
100 Mbps LAN	20-40	100-200	500-750	3,500-7,000	1,500-3,000
1 Gbps LAN	200-400	1,000-2,000	5,000-7,500	35,000-70,000	15,000-30,000
Wide Area Networks Bandwidth	Concurrent Client Loads				
	File Servers	SDE Servers	X Emulation	Windows Terminals	Web Products
56 Kbps Modem	NR	NR	NR	2-4	1-2
128 Kbps ISDN	NR	NR	NR	5-10	2-4
256 Kbps DSL	NR	NR	1-2	10-20	5-10
512 Kbps	NR	NR	3-6	20-40	10-20
1.54 Mbps T-1	NR	1-2	9-12	50-100	25-50
2 Mbps E-1	NR	1-3	11-16	75-150	40-80
6.16 Mbps T-2	1-2	6-12	30-45	200-400	100-200
45 Mbps T-3	10-20	50-100	250-350	1,500-3,000	700-1,500
155 Mbps ATM	30-60	150-300	850-1200	5,000-10,000	2,500-5,000

If the existing network is already taxed, then network requirements should be re-evaluated and enhanced for the deployment of a GIS server. Network bandwidth between client workstations and the associated GIS data server should be supported with dedicated 100-Mbps switched connections.

ArcGIS and ArcIMS client loads from the GIS User Load Summary chart were used to identify network bandwidth requirements in the chart below (Figure 13). The total required bandwidth can be compared with the available network bandwidth, in this case the 100-Mbps LAN. ESRI has determined that LAN environments become saturated at 25%-35% bandwidth utilization, and should be upgraded to avoid saturation. As seen from the following LAN Network Suitability Analysis chart, the current GIS load only requires 1.5% of the available LAN resources, while in YR 2006 it is estimated to be around 10%. Again, this is an optimistic network analysis since it only considers GIS utilization, while the same network must support other Corps business traffic.

**Figure 13 - LAN Network Suitability Analysis**

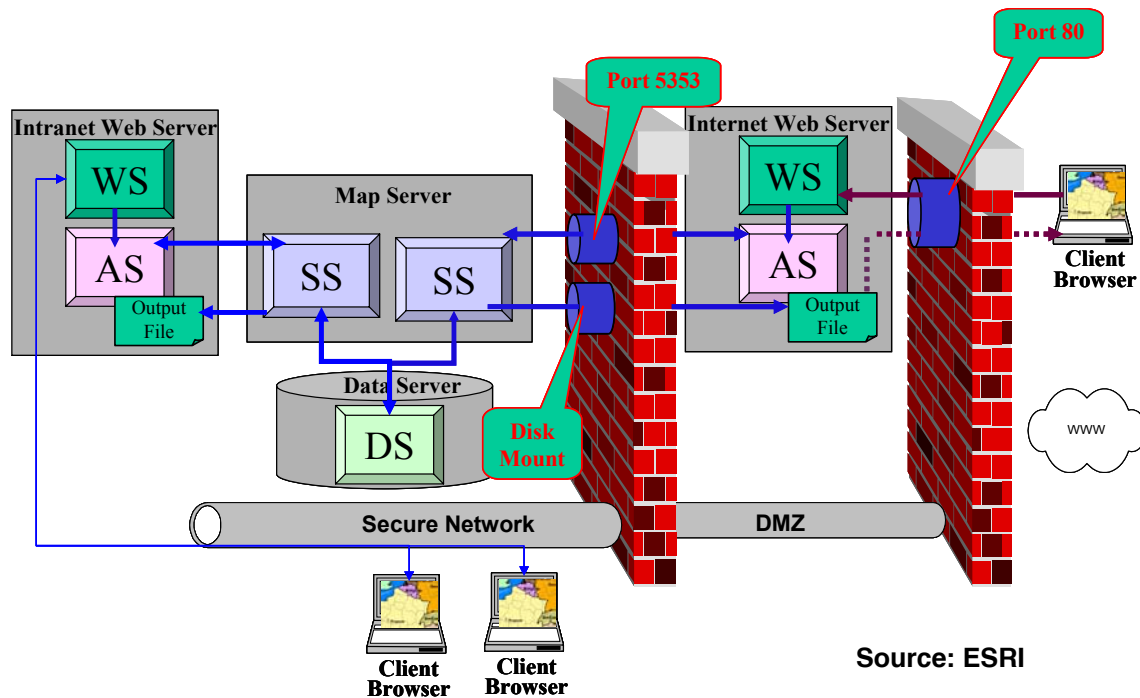
	<b>ArcGIS Desktop (Peak Load)</b>	<b>ArcGIS Desktop (0.5 Mbps)</b>	<b>ArcIMS Req/Hr (Peak Load)</b>	<b>ArcIms Req/Sec (3600 Sec)</b>	<b>Bandwidth Required (Mbps)</b>
<b>2004</b>	3	1.5	0	0.00	1.50
<b>2005</b>	7	3.5	0	0.00	3.50
<b>2006</b>	20	10	100	0.03	10.03

There is a concern that bandwidth utilization is not sufficient to implement an ArcIMS server in YR 2006 over the WAN for Internet access to the GIS information. Currently, Internet access has been informally tested at 128 Kbps which will only support 2-4 web GIS clients. A future conservative estimate would assume that over half of the 100 peak ArcIMS clients will be outside the Corp's 100-Mbps LAN, and will be utilizing the WAN to connect to the ArcIMS server. The WAN will require an upgrade to a dedicated 6.16 Mbps T-2 connection to the Internet in order to support the specified number of web GIS clients.

### **ArcIMS Security**

Figure 14 shows a summary of the recommended firewall configuration supporting ArcIMS as a shared map server, developed by ESRI. This configuration provides the greatest protection of the ArcIMS components on the secure network and leverages the Corps existing web server arrangement. The DMZ is established by a firewall providing Internet traffic with Port 80 access allowing HTTP traffic to reach the existing Web server. The Map server is connected by Port 5300 to the web server in the DMZ. This arrangement allows the ArcIMS map server to support map requests both internally on the Corps' LAN Intranet and externally via the Internet. The Web server shares the output file disk with the map server to support one-way traffic to put images in the output file for Intranet access. ArcIMS supports many other security configuration options, which can be found in ESRI System Design Strategies White Paper

**Figure 14 - ArcIMS Shared Map Server**



## 5 Implementation Strategy

A phased implementation approach requires good planning to best allocate resources and better ensure correct alignment of systems with project requirements. This section provides an overall implementation strategy and it is recommended that a three-year strategic plan be developed to address budget needs and future planning.

### 5.1 Schedule

This implementation is divided into three phases including short-term immediate actions, YR 2005, and YR 2006.

#### 5.1.1 Short term

Early in YR 2004, the GIS lab should be cleaned and outdated computer equipment removed to provide sufficient space to layout maps and allow access to the large format digitizer and plotter. Next, staff computers should be upgraded to the recommended GIS workstation configurations and to the latest ArcGIS software release. The proposed investments in computer hardware and software will only yield the anticipated benefits if the data documentation and metadata creation are performed. These responsibilities fall upon all Corps staff performing GIS activities.



Initially, GIS data for the project should be loaded and maintained on the GIS workstation that is located in the GIS Planning Lab until the GIS server has been purchased and configured later in the year. It is during this time that quality control procedures be implemented for the data and project files.

The Corps Planning GIS staff should work collectively with the LA District's GIS Committee on compiling data and loading it on the enterprise file server. IMO management have communicated that they are currently understaffed and will not facilitate the purchasing of new equipment for GIS activities (i.e. new enterprise GIS server, ArcIMS, ArcSDE-Oracle, etc.) without additional staff augmentation. At this time, it is imperative to garner the support of the IMO staff to install and maintain the new GIS file server so it is connected to the LAN and the data is securely backed up and archived offsite. IMO support is necessary for further enhancements to the LA District's GIS activities in the following years.

### **5.1.2 YR 2005**

At first, the GIS data server will be employed as a file server to store and retrieve GIS project files. Data will then migrate to the ArcSDE-Oracle repository in YR 2005. This will require the purchase and installation of a relational database such as Oracle and the complimentary ESRI ArcSDE software. Additional staff will be necessary to successfully implement this new technology. As the Corps moves to an enterprise approach organized around a multi-user geodatabase in ArcSDE-Oracle, there will be a need for a qualified database administrator familiar with ESRI's ArcSDE technology. The Corps' GIS Analysts will not have the time or expertise to maintain this technology alone. Initially, this administration function can be outsourced to the private sector until the Corps' IMO has either augmented or trained their staff.

Subsequently, the database design will be carried out to optimally store existing data for improved retrieval, maintenance, and growth. Once the database design has been developed, tested and approved, the GIS layers will be loaded following a standardized migration procedure. On successful migration, a first level database tuning will be performed. Once users start using the ArcSDE-Oracle repository, timely performance monitoring and tuning will be necessary to keep the system in good health. At this time performance tuning of the database and ArcSDE will be employed to optimize workflows such as data loading and maintenance. The deployment and maintenance of ArcSDE and an Oracle relational database will require specialized training for the Corps staff, which is available from the software vendor or from reputable software training companies.

### **5.1.3 YR 2006**

Communications upgrades to the WAN will be required to support the deployment of an ArcIMS shared map server in YR 2006. Once again, IMO support will be critical to support and determine the correct configuration of the ArcIMS map server that fits within their USACE security specifications. Additional training will be necessary for the IMO staff to properly configure and maintain the ESRI ArcIMS map server. Initially, the ArcIMS map server may be implemented to only serve clients internally to the USACE

and then subsequently provide access outside of the LA District's firewall. As mentioned earlier, there are many ArcIMS firewall configuration alternatives that are outlined in the ESRI System Design Strategies White Paper that should be examined prior to implementation.

## 5.2 Hardware

The main focus for performance and work-flow improvements for the Planning GIS staff will be the implementation of new desktop workstations and a GIS server. Proper hardware selection is only one primary factor in the overall system architecture that can contribute to improvements in system performance.

The useful machine life is considered the amount of time where current software releases are supported on a piece of equipment. The useful life for laptop and workstations is three years, data servers average between three to four years, and local area networks can go up to seven years. Since computer technology ages at a rapid rate, it is important to budget for replacing old hardware before it costs more to maintain than to replace.

### **GIS Workstations**

There are three primary categories of GIS user workstations: professional, casual, and browser. A high-performance configuration would benefit from dual 19-inch monitors to support professional GIS activities running ArcGIS ArcInfo, ArcEditor, and ArcView. GIS power users that typically run background batch processes in one window while working in another. A mid-performance machine for the casual user would have a similarly equipped machine with a single monitor to run ArcGIS ArcView, but would only require half of the RAM as the high performance configuration. The browser or terminal client would be the typical office machine. The primary operating system for ArcGIS is the Windows NT/2000/XP environment. Figure 15 provides an overview of platform-sizing recommendations for GIS workstations.

**Figure 15 – Recommended GIS Workstation Configurations**

Category	Client Application	Platform	Memory	Display
<b>Professional</b>	ArcGIS ArcInfo/ArcEditor/ArcView	Pentium 4 3.20+ Ghz	1 GB	Dual 19" Flat Panels
<b>Casual</b>	ArcGIS ArcView	Pentium 4 3.20+ Ghz	512 MB	17" Flat Panel
<b>Browser</b>	ArcIMS Browser	Pentium 4 2.40+ GHz	256 MB	15" Flat Panel

The current GIS workstation in-use by Corps' GIS staff has exceeded their useful life of three years from their introduction by Dell in November 2000. It is recommended that these machines be replaced with new equipment such as a Dell Precision 650, with 1 GB RAM and dual monitors. Appendix D provides detailed professional GIS

workstation specifications. The new Dell workstations will provide the necessary computer processing and display upgrades to maximize GIS staff productivity.

### **GIS Server**

Based upon the requirements gathered, the recommended centralized system as shown in Figure 16 includes a central data server with a dual processor and 730 GB storage capacity. The following table identifies the recommended GIS server and the associated cost. The detailed GIS server hardware specifications can be found in Appendix E.

**Figure 16 – Recommended GIS Data Server**

<b>Specification</b>	<b>Cost \$</b>
Server – Dell PowerEdge 2650 <ul style="list-style-type: none"> <li>• (2) 3.06GHz Intel Xeon Processors</li> <li>• 2.0GB DDR RAM</li> <li>• RapidRails for Dell Rack</li> <li>• Windows 2000 Server w/5cal</li> <li>• On-Board RAID 5</li> <li>• (5) 146GB 10K RMP Ultra 320 SCIS Hard Drives (730 GB Total Capacity)</li> </ul>	\$10,525
Rack – PowerEdge 4210*	\$1,000
Tape Backup – Dell PowerVault 110T, SDLT <ul style="list-style-type: none"> <li>• 160/320GB External Drive</li> </ul>	\$6,246
APC Smart-UPS 3000 RM XL*	\$2,000
<b>TOTAL</b>	<b>\$19,771</b>

\*Based upon IMO specification for GIS Web Server dated 08-25-2003.

## 6 References

ESRI, "System Design Strategies", An ESRI White Paper, June 2003.

U.S Army Corps of Engineers. "Engineering and Design GEOSPATIAL DATA AND SYSTEMS", Engineering Manual No. 1110-1-2909, August 1996.

U.S Army Corps of Engineers. "Enterprise GIS: Needs Assessment, Findings, and Implementation Recommendations, Portland District", The Remote Sensing/GIS Center Cold Regions Research and Engineering Laboratory – Hanover, New Hampshire, January 2001.

U.S Army Corps of Engineers. "Geospatial Information System (GIS) Sub-Process Action Team", Mississippi Valley Division, April 1999.

U.S Army Corps of Engineers. "Needs Assessment for U.S. Army Corps of Engineers Mobile District", Michael Baker Jr., Inc., August 1998.

U.S Army Corps of Engineers. "Geographic Information System (GIS) Implementation Plan for U.S. Army Corps of Engineers, Mobile District", Baker GeoResearch, May 1999.

U.S Army Corps of Engineers. Memorandum "Data Standards for Computer Aided Drafting and Design (CADD), Geographic Information Systems (GIS) and Related Technologies", DAIM-MD (AR210-20), October 16, 2001.

## **Appendix**

**A GIS User Need Survey**

**B Information Management Office (IMO) Network Diagram**

**C GIS Data Research and Collection**

**D Recommended Workstation Specifications**

**E Recommended Server Specifications**

**Appendix A**

**GIS User Need Survey**

# GIS User Needs Survey

Name/Title: Claudia Avendano  
Department: Coastal Studies Group

Reports To: Anthony Risko  
Date/Time: 27 Oct 2003

1.1 Department Mission and Purpose Statement: Army Corps of Engineers

ACOE, and Civil Works Mission and purpose statements attached

1.2 Organization Chart Attached? Yes

1.3 What are the functions that you/your department are responsible for?

As a Planner within the Planning Division Coastal studies group I serve as a study manager for complex and broadly scoped studies involving the planning of Federal coastal and water resources projects related to coastal navigation, shoreline protection, ecosystems restoration and enhancement, coastal watersheds and sediment management and water quality and land improvements. Responsible for developing and executing a study program for assigned studies, to include directing and managing in-house technical staff and A-E contracting resources; formulating and recommending plans, impact assessment and evaluation, and selection of the final plan to include Fed and non Fed requirements for recommendation to the district; preparing study reports and responding to comments and issues; and, coordination of assigned study results and other matters with higher authorities at Division level, Federal and non Federal agencies and other public interest.

My responsibilities for specific projects can be described as follows:

To emphasize Regional Management Business Process RMBP to improve the ACOE business process and following the organizational goals within my division by providing hi priority GIS support to projects and project mangers within the San Diego area (my area of support) and when possible to any other project within the division in “as need it” bases.

- 1) Maintain excellent relationship and continued to provide excellent service to all local sponsors on assigned studies by facilitating the understanding of the technical aspects of projects trough the use of powerful GIS/PowerPoint visual

- displays and presentations at Technical Advisory Committee Meetings and other public outreach efforts related to the Master Plan, and serving some times as a translator- coordinator for Spanish speaking audiences.
- 2) Maintain significant progress towards completing the following Studies:
    - a. Morro Bay: Successfully met all deadlines for work products in support of the project. Assist in developing state of the art methodology for environmental restoration model and produced hi quality usable accurate and supportable results.
    - b. Master Plan: Developed scope of Work and assist contractor in developing GIS protocols and metadata Promoting State of the art technologies and research by supporting study manager in reviewing the technical aspects of scope of work documents related to Development of a GIS system for the Master plan. Jointly with Senior Coastal Planner Susie Ming serving as ACOE representative in the Coastal Sediment Management Work Group and heading the GIS initiative efforts for the Master Plan. Serving as technical study manger providing feedback to finalize scope of work and contracting. Provide all necessary information and feedback to State's project manager.
    - c. San Luis Rey River. Develop GIS database and maps showing aerial photograph, topographic maps, and environmental data depicting current conditions and projecting environmental restoration alternatives. Assist in the fieldwork design by providing maps and other visual aids to design sample locations and providing coordinates for GPS field rectification. Creation of Complex maps overlapping fieldwork findings and environmental restoration alternatives with results and maps provided by other agencies for quality control and analysis.
    - d. Provide GIS assistance as need it with aerial photographs, maps, information gathering and download, attending public meetings, providing technical advice, establish GIS technology transfer protocols between ACOE and its contractors as well as with local sponsors for GIS in-kind credits to the following projects: LA3, Ballona Wetlands, San Elijo Lagoon, Solana Beach, Ventura Harbor GIS prototype, WATTS, Peninsula Beach.
    - e. Assist Study Manager in environmental restoration project Mission creek (206) to develop fieldwork data collection and methodology for establishing environmental parameters to visualize current conditions and project environmental restoration alternatives.
  - 3) Provide Assistance to Senior Coastal Planners in Developing Reconnaissance Studies, met or exceeded senior study manager expectations in developing of technical and management support tasks assigned for Morro Bay, California Sediment Management Master Plan, GIS Master Plan, and occasionally all others previously mentioned.
  - 4) Assist in all contracting issues to achieve the specific percentage of subcontracting efforts according to the Planning Division's guidelines by developing specific scope of work for incremental cost-benefit analysis for



- beneficial use of maintenance dredging material and supporting study manager in reviewing the technical aspects of scope of work documents related to a quality assurance/quality control (QA/QC) for Morro Bay feasibility study and the next project face of alternatives evaluation. Contracted Assistance to design systems architecture in support to Master Plan GIS and developing of GIS/IMS
- 5) Continue to develop coastal planner skills by attending the annual planning conference, the goal setting planning conference, requesting the available core training for FY04 and independently studying the civil works manuals. Continue to pursue university training in sediment management, GIS, Decision Support Systems Tools, Coastal Process, Coastal Policies and Coastal Planning to ensure state of the art knowledge application in California Sediments Management Master Plan, and Regional Sediment Management initiatives at local and national level.
  - 6) To foster team work by managing delegating, and providing specific information regarding workload distribution, studies objectives and clear goals settings, and regular up-date meetings with other GIS team members. Supporting other GIS team members by ensuring proper training and granting access to adequate hardware, software, and ensuring license maintenance to other GIS team members within the planning division. All issues are successfully coordinated at study team level including intra-branch studies such as Watts, Mission Creek and San Luis Rey River. For Morro Bay study all technical issues were successfully coordinated and sound conclusions were reached at study team level by providing a climate of open communication among all team members to maintain consistency of technical products through ERB, ED, local sponsor, and other agencies involved in the project such as NOAA, NEP, EPA, achieving highly satisfactory usable accurate and supportable results.
  - 7) Design and implement protocol for systematic documentation of data processing analysis and fieldwork observations for all GIS related work in coordination with other GIS team members for each study assigned.
  - 8) Promoted state-of-the-art technologies and expanded in-house capabilities through successful coordinating contractors and in-house staff in developing a GIS database for Morro Bay Estuary and the California Sediment Management Master Plan, as well as providing GIS capabilities to the Coastal Studies Group and expanding to the whole planning division level. Meeting with DE to foster the creation of GIS in-house capability at District Level and representing local expertise. Promoting State of the art technologies and research by organizing a workshop with the University of Southern California and the National Science Foundation to foster the cooperation among these institutions and the Corps project development. Applying state-of-the-art technologies by developing a (GIS) prototype system to provide for systematic analysis of appropriate dredging and conveyance options available in coastal California under the jurisdiction of the Los Angeles District. Promoting State of the art technologies and research by fostering the development of a Center for Coastal Expertise with the University of Southern California and the National Science Foundation to foster the cooperation

- among these institutions and the Corps and by serving as a liaison with this institution for possibly establishing a cooperation agreement for the USC to provide training in accordance to ACOE training policies
- 9) To maintain Effective Quality Control of all study products assuring conclusions and recommendations by thorough following scientific methodology and by following the principles of completeness in consistency with Corps requirements making use of in interdisciplinary review meetings, first line supervisory review and independent technical review in accordance with HQ, SPD, and SPL Guidelines. For the Morro Bay project none of the technical reviews found significant issues, the study was proven to produce hi quality usable accurate and supportable results, where SPD felt comfortable waiving the F3 conference

1.4 What staffing exists in your department? (Include work status (part/full time) and indicate job function)

GIS specific personnel for the whole planning division consists in two GIS Analyst Ms. Martin (Full time) and me (full time) Ms Martin serves as a GIS 8 and up specialist and my self as a technical study manger in the above mention studies and as Arcview 3x expert. There's only another GIS user within the planning division in the Environmental Studies Branch, her name is Anita Allen, and I'm not familiar with her job functions.

She can be contacted at (213) 452-3842 or Anita.A.Allen@spl01.usace.army.mil

1.5 What computer equipment do you presently use in your department? Include PCs, printers, plotters, scanners, etc. For personal computers, include the operating system version.

2 Dell Workstation PWS 330 Intel Pentium ® 4 CPU 1400 MHz AT/AT compatible 1,047,632 kb ram 70G hard drive and one lap-top with same processor specification and 20G hard drive. Plotter HP Design jet 800 PS, 2 printers Hp LaserJet 1200 Series.

Scanner digitizers and Sun Workstation are obsolete.

1.6 What inefficiencies or bottlenecks exist within your organization? (i.e. slow network, old computers, outdated software?)

Slow network and very slow hiring process as of to achieve a reasonable workload per individual within the organization.

2.1 Does your particular department have a budget for operating a GIS? Will they in the future?

We will in the future, but basically all GIS development has to be budget at individual studies level. Only software was bought from overhead account.

2.2 Does your staff have any special CAD/GIS background or training? Please list the types of software (i.e. Arcview, MapInfo, AutoCAD, Microstation).

Ms Martin and me have GIS Analyst diplomas/ certificates from USC, Ms Martin has received Arcinfo training. I don't know of any other GIS certified personnel within the organization. At engineering Division we have some people with CADD and Microstation Experience and some self taught GIS users. ACOE has two GIS prospect training classes at basic level but users complain that even after taking both classes they can't really operate even the basic Arcview functions.

2.3 How many staff members use GIS in your department? Please acknowledge which GIS users work daily in the office or in a remote location? indicate job function)

In my department only Ms Martin and me, however there's about 30 GIS users within the organization. The member of the GIS committee group according with the lattes list are:

SPL GEOSPATIAL DATA & SYSTEMS TECHNICAL COMMITTEE MEMBERS			
Name	Organization	Telephone Ext.	Function/Specialty
Kurt Hoffman	CESPL-IM-S	3411	Regulatory Branch GIS System Admin & Database Manager
Daniel Swenson	CESPL-CO-R	3414	Regulatory
Y. Jae Chung	CESPL-CO-R	3292	Regulatory
Joe Evelyn	CESPL-ED-H	3525	Chief, H&H Branch
Brian Tracy	CESPL-ED-HR	3527	Chief, Reservoir Regulation Section
Greg Peacock	CESPL-ED-HR	3536	Water Control
Don Queen	CESPL-ED-HR	3531	Water Control Data Sys Admin
Kerry Casey	CESPL-ED-HH	3574	Hydrology & Hydraulics
Art Shak	CESPL-ED-DC	3675	Chief, Coastal Engineering Section/CADD Sys Manager
Claudia Avendano	CESPL-PD-CN	3832	Coastal Planning
Armando Moneu	CESPL-RE-P	3138	Real Estate
Thad Fukushige	CESPL-CO-SE	626-401-4048	Superfund Site Management
Mo Chang	CESPL-CO-ON	3405	Chief, Navigation Section
Keith Ayers	CESPL-CO-ON	3389	Navigation
David Snuggs	CESPL-IM-RP	3226	IM

2.4 Please list the number of GIS users (total and peak) by each type of GIS software for the current and future years.

	ArcGIS 8.x		ArcView 3.2		ArcIMS Web Mapping
Year	Total	Peak	Total	Peak	Requests/Hr.*
2003	1	2	1	2	?
2004	2	4	2	2	?
2005	5	10	2	2	?

\*ArcIMS is a scalable Internet mapping solution that can be easily scaled from 10 to 10,000 map requests an hour.

3.1 What current mapping/GIS procedures and specifications currently exist in your department?

None formally established

3.2 Please list all the different types of map data that your department currently creates and utilizes. Who maintains it? Include both computerized and hard copy sources and include the date and map scale if known.

Ms. Martin and me maintain all spatial data as is required for each of the previously mention projects. We basically deal with shape files, arc info coverages, cadd data, dwn and dwg files from Microstation, aerial photogtaphs, Ascii (yxz files) for bathymetry, hard copy and screen digitized maps, and we will be dealing with lidar/ shoals data in a near future.

3.3 Do you share any geographically related data with any other departments, agencies, etc.?

Yes, and we will share all info type acquired and storage through the Master plan. I'm assuming by now you are familiar with this type of info, but please let me know if you need me to elaborate in this.

3.4 What GIS related applications are currently being used in your department?

Arc view 3.0, 3.2, 3.3 and a lot of downloaded extensions, version 3x Spatial analyst and 3d analyst ARC GIS , 8.2 8.3 Spatial Analyst, 3D analyst, Arc toolbox, Arc catalog, Arc editor, Statistical Analyst, military analyst, geography network, and learning image analyst

3.5 Please list and describe the use of any web-based mapping applications that are either internal to your organization or are available on the Internet.

There are two applications, Corps Map and LAD map servers, which supposed to be like a browser-based map tool (IMS) but they are very rustic in functionality and due to the very slow network speed are really inoperable.

3.6 What new applications would you like to see implemented in your department that would help you in your work?

Improvement in the map servers, WebPages, inventory of current information standardized metadata, and projections, better-established users network and improvement in the operability of ARC GIS concurrent licenses over the net

4.1 Any other additional comments?

## GIS User Needs Survey

Name/Title: Kerry Casey

Department: H&H

Reports To:

Date/Time: 20 Nov 2003

1.1 Department Mission and Purpose Statement:

Hydrologic & Hydraulic Modeling

1.2 Organization Chart Attached? ☐

1.3 What are the functions that you/your department are responsible for?

Hydrologic & Hydraulic Modeling

1.4 What staffing exists in your department? (Include work status (part/full time) and indicate job function)

~ 140 in Engineering Division

1.5 What computer equipment do you presently use in your department? Include PCs, printers, plotters, scanners, etc. For personal computers, include the operating system version.

Dell Precision workstations - Windows 2000

letter to e-size scanners

up to e-size plotting

full range of printers

1.6 What inefficiencies or bottlenecks exist within your organization? (i.e. slow network, old computers, outdated software?)

Extremely slow internet access; internal network OK. Slow servers. Insufficient file storage space.

2.1 Does your particular department have a budget for operating a GIS? Will they in the future?

No! Hope so!

2.2 Does your staff have any special CAD/GIS background or training? Please list the types of software (i.e. ArcView, MapInfo, AutoCAD, Microstation).

Microstation

ArcGIS

2.3 How many staff members use GIS in your department? Please acknowledge which GIS users work daily in the office or in a remote location?

Engineering Division ~ 40-50 including about 5 at El Monte Baseyard

2.4 Please list the number of GIS users (total and peak) by each type of GIS software for the current and future years.

	ArcGIS 8.x		ArcView 3.2		ArcIMS Web Mapping
Year	Total	Peak	Total	Peak	Requests/Hr.*
2003	40	15	20	5	
2004	60	30	20	5	
2005	80	40	15	3	

\*ArcIMS is a scalable Internet mapping solution that can be easily scaled from 10 to 10,000 map requests an hour.

3.1 What current mapping/GIS procedures and specifications currently exist in your department?

Individual how to procedures

Spatial data standards

CADD standards

3.2 Please list all the different types of map data that your department currently creates and utilizes. Who maintains it? Include both computerized and hard copy sources and include the date and map scale if known.

DEM, dtm, topo, etc

streets, rivers, watersheds, counties, states, etc

gages, climate, fire data, floodplains, etc

maintained by 2-3 individuals in Engineering Div.

3.3 Do you share any geographically related data with any other departments, agencies, etc.?

Yes, thru a GIS file server designated as “X” drive

3.4 What GIS related applications are currently being used in your department?

ArcInfo

ArcEditor

ArcView

Topo

SureMaps

Eagle Aerial Fotos

InRoads - Microstation

3.5 Please list and describe the use of any web-based mapping applications that are either internal to your organization or are available on the Internet.

MapServer (In-progress)

3.6 What new applications would you like to see implemented in your department that would help you in your work?

.dtm to .tin conversion in ArcMap

ArcMap front end for adding spatial data

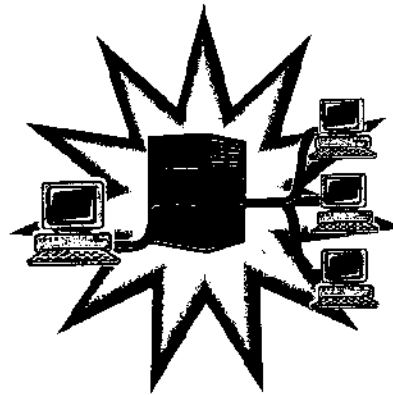
4.1 Any other additional comments?



## **Appendix B**

### **Information Management Office (IMO) Network Diagram**

# US Army Corps of Engineers Los Angeles District



Network Diagram  
October 2003

# Current Configuration

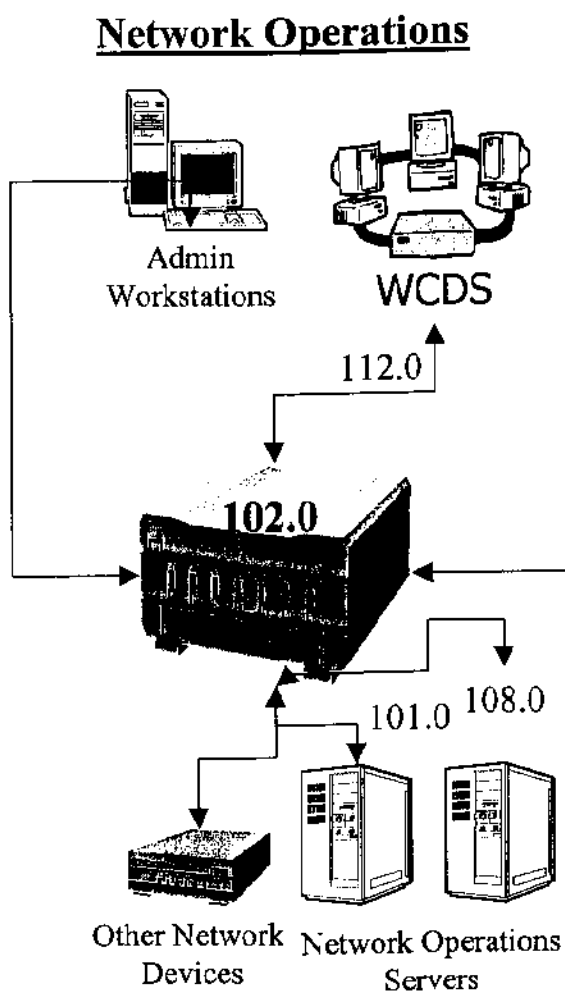
- CESPL LAN
- CESPL WAN

# CESPL LAN – 1

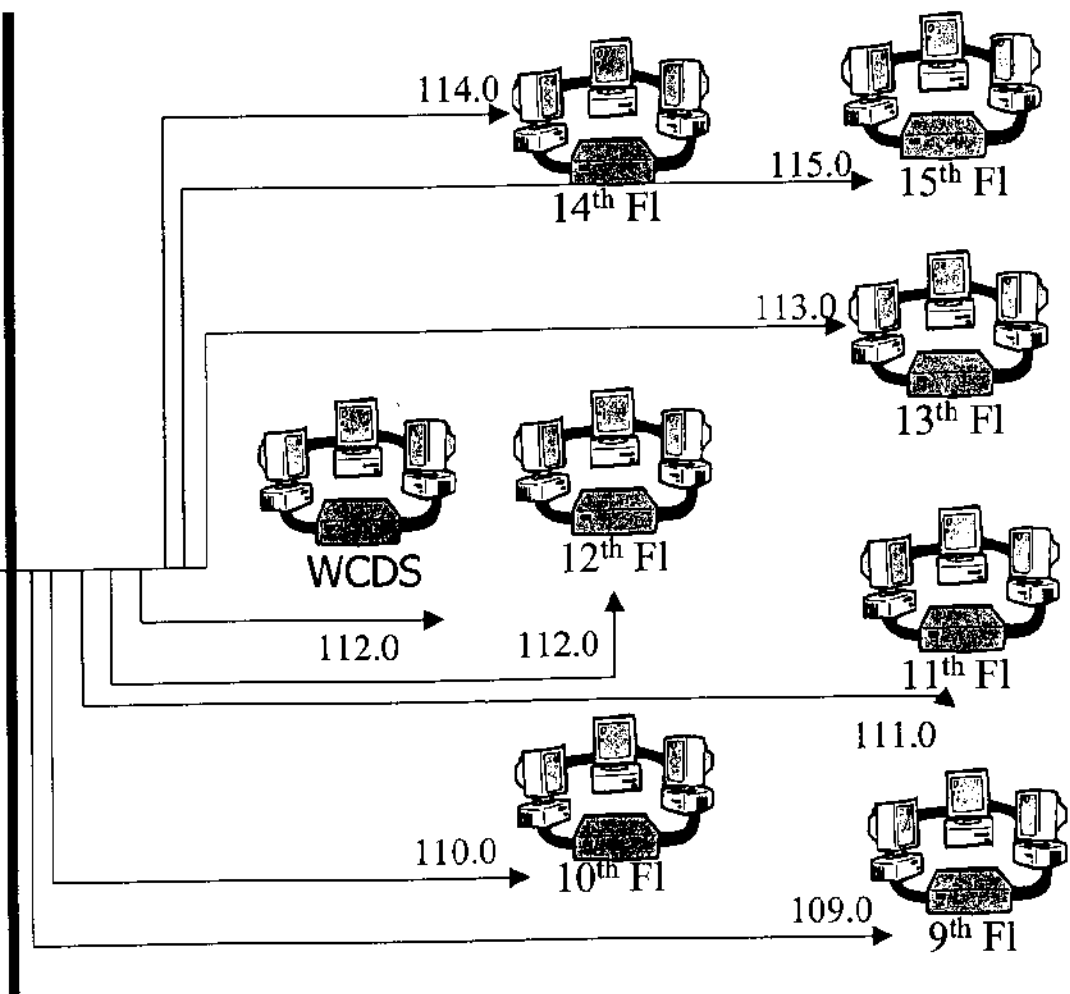
- Operating Systems
  - Server OS – MS Windows NT4/2000, Unix
- Networking Protocols – TCP/IP based only
  - NetBT and IP
  - TCP or UDP (SMTP, LPD, SNMP, NTP, HTTP, etc only)
- Servers
  - Network Services (NTP, DNS, SMTP, LPD, FW)
  - Network Resources (File, Print, Exchange, Application, Web)
  - Network Authentication (PDC/BDC, Application keys)

# CESPL LAN – 2

## Network Operations



October 2003



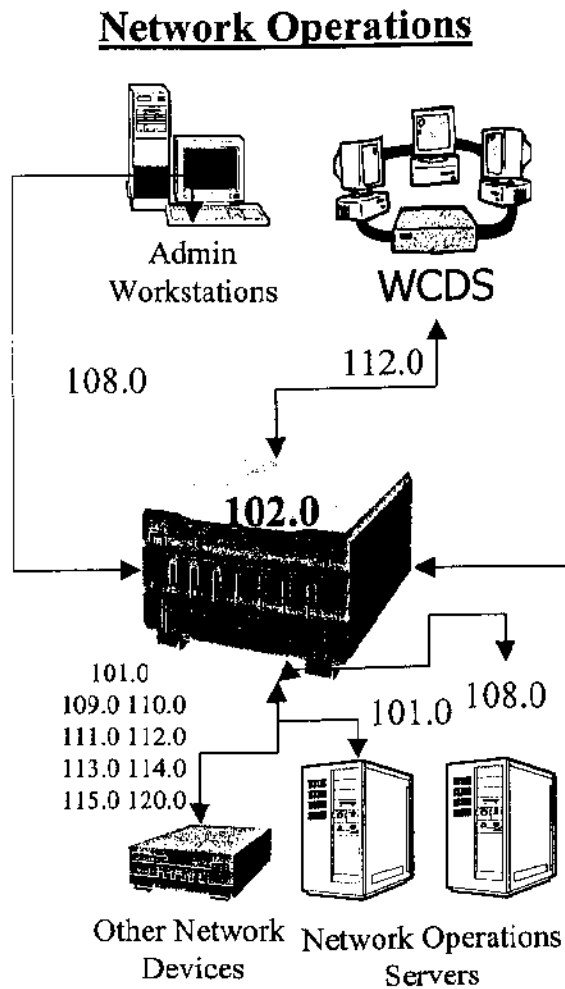
CESPL Network Diagram

# CESPL LAN – 3

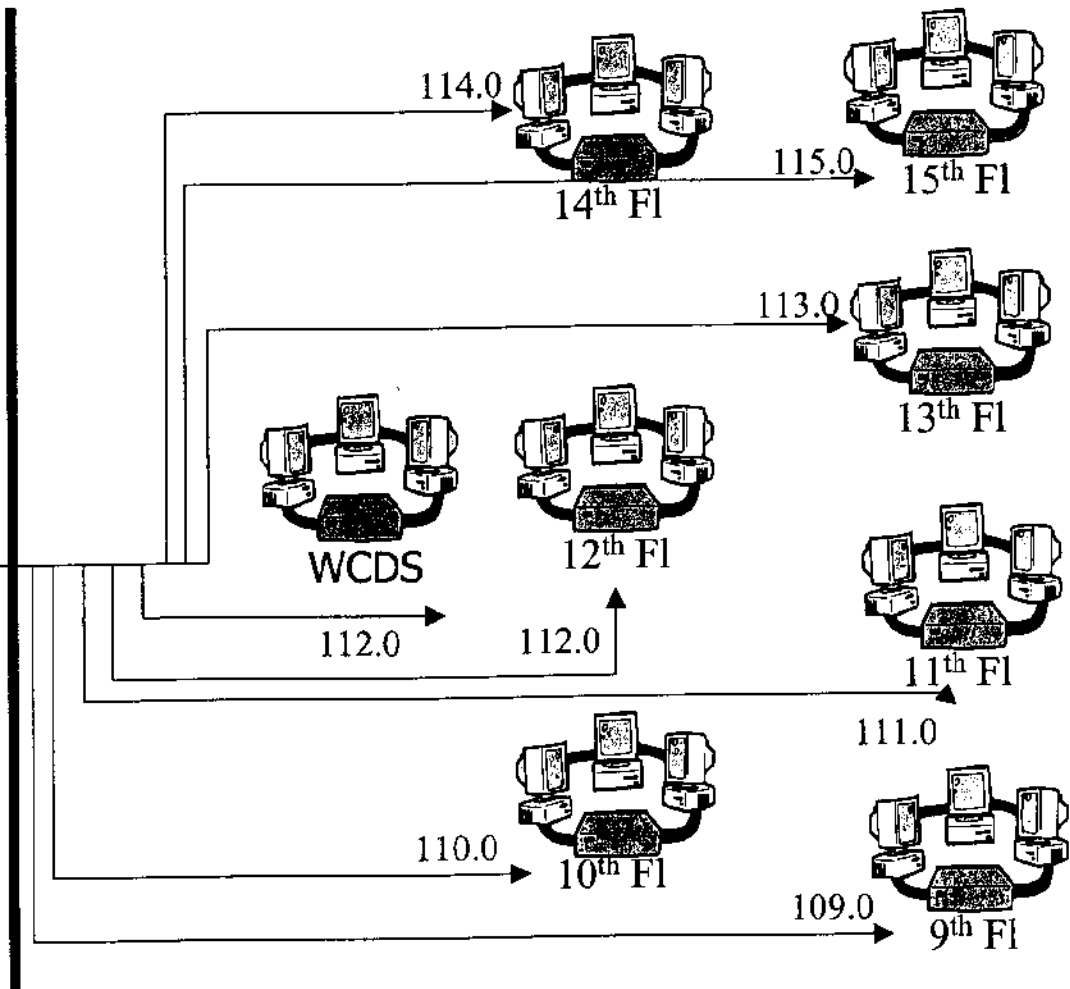
- Two (2) Layer 3 Switching Cards
  - 155.83.102.0 subnet used as bridge between both cards
- RIP V2 support in V3.0 software
- IP subnets correspond to physical locations
  - Floors at 911 Wilshire Blvd; field office locations
  - IP address range 155.83.100.0 thru 155.83.149.0
  - 24 bit subnet masks (Class C subnet masking) by default

# CESPL LAN – 4

## Network Operations



October 2003



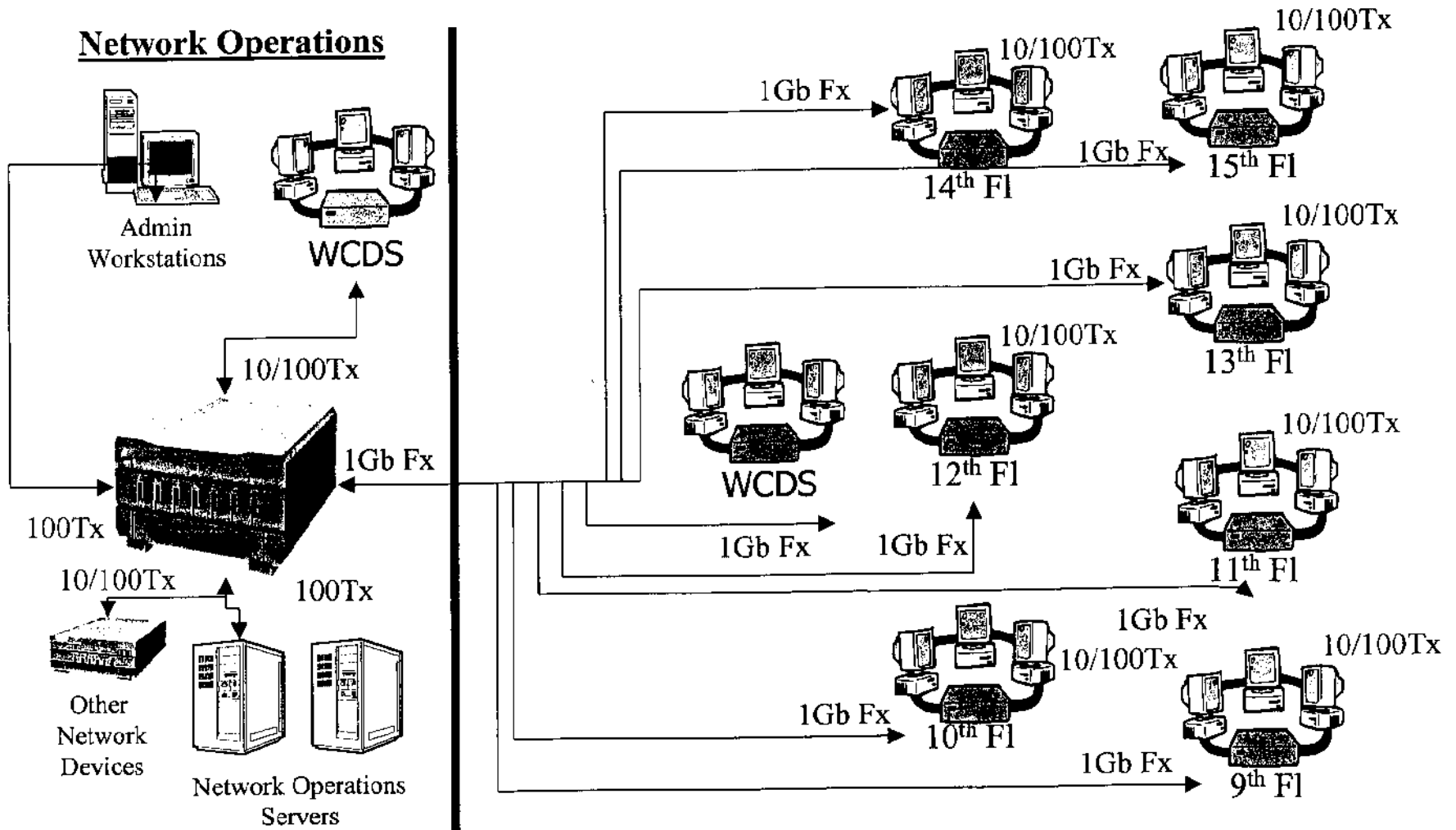
CESPL Network Diagram

# CESPL LAN – 5

- 32 GB Backplane Switching Hub
- 2 Gb trunk per card
- 2+ - 1Gb Fx Ethernet links per Floor
- 100MB Tx Ethernet to the desktop
- VLAN support across switching cards
  - VLANs defined to match IP subnets



# CESPL LAN – 6

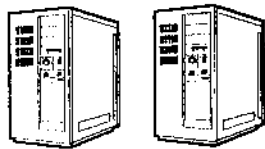


October 2003

CESPL Network Diagram

# CESPL LAN – 7

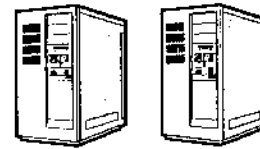
## Network Operations Servers



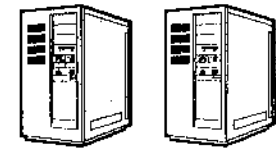
WinNT  
3 Exchange Servers



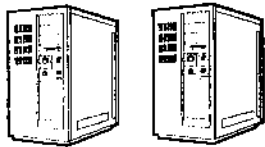
5 Admin  
Workstations



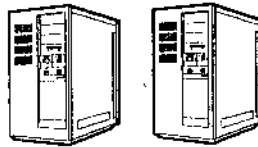
Unix District  
Internet Server



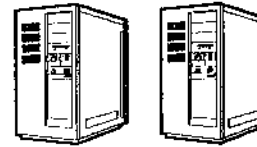
Unix SNMP Workstation  
Backup Server



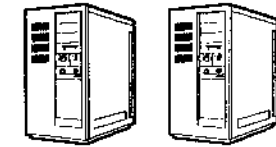
WinNT  
2 Domain Controllers



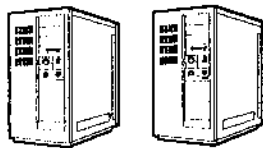
WinNT  
Primary Backup Server



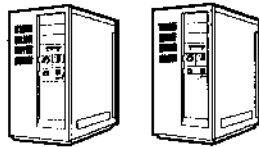
WinNT  
IIS Intranet Web Server  
Exchange OWA Server



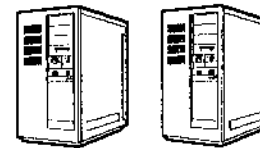
2 Unix DNS Servers



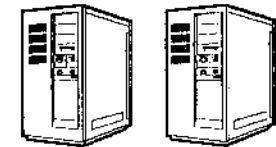
WinNT  
Unicenter AHD Server



WinNT  
3 Unicenter AMO/SDO Servers



WinNT  
2 Print/3 File Servers



Unix  
2 Print Servers

# CESPL WAN

- IAS Segment
  - District Web Server/FTP Server (receives data updates from production segment CWMS server)
  - Electronic Bid Server for CT/ED
- CIAS Segment
  - WebMail
  - Lotus Notes

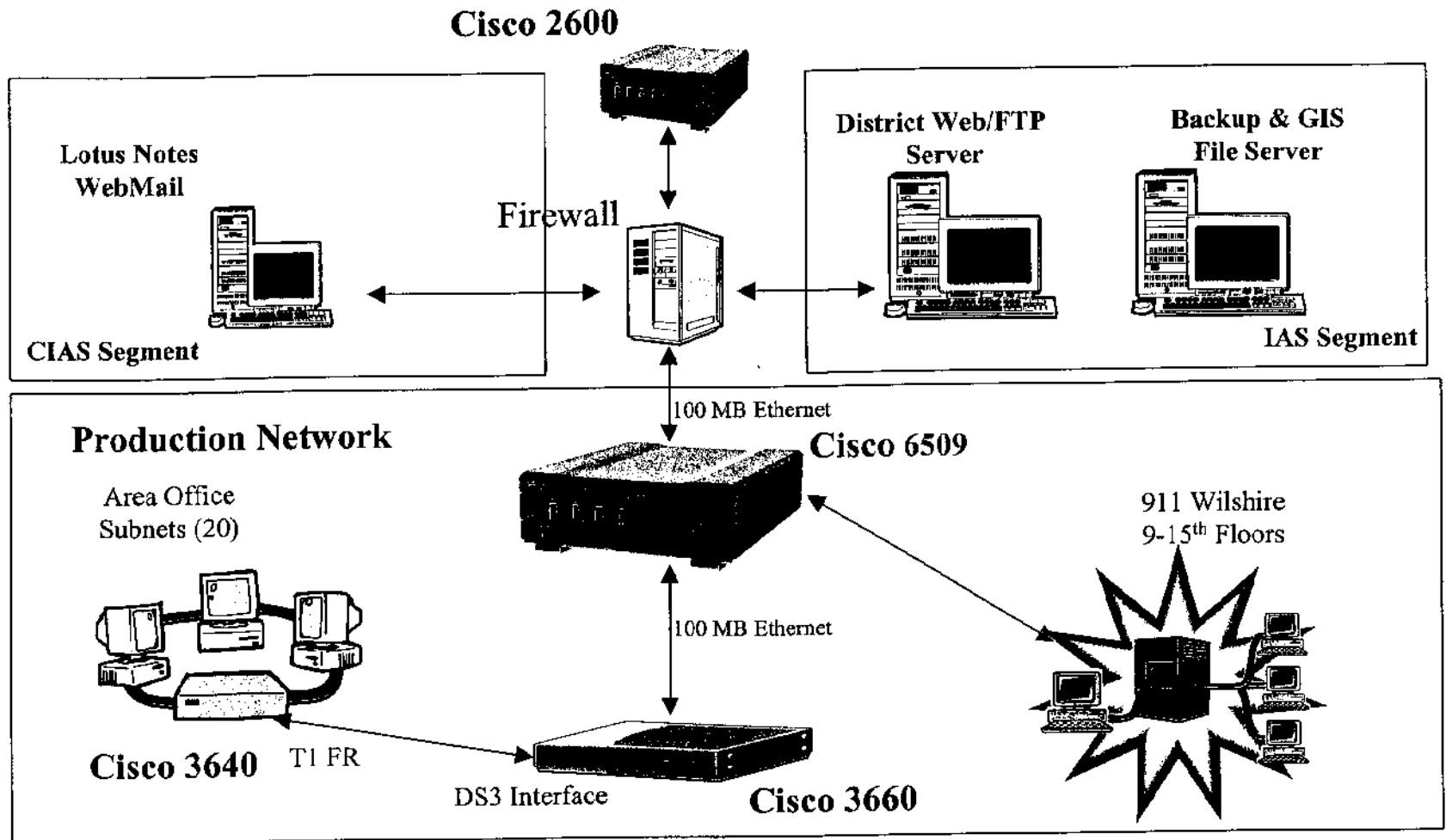
# Area Offices/Resident offices

- About 20 remote offices
  - Area Offices at Palmdale, CA; Phoenix, AZ; March ARB, CA; El Monte, CA
  - 18 Offices have T1 FR Link to District DS3 interface
- All offices upgraded to 10/100MB Tx switches

# Area Offices/Resident offices

- T1 Frame Relay to Baseyard/Field Offices
  - 911 Wilshire site w/DS3 support to field
  - Two (2) dial-in only remote access devices (RADIUS authenticated)
  - 23 56K digital unit to T1 ISDN trunk
  - 24 28.8 analog modem bank
  - Separate 800/888 numbers for each device

# CESPL WAN



October 2003

CESPL Network Diagram

13

# GIS File/Backup System

- Dell 1750 Server (rackmount)
- Veritas DataCenter Backup
- Dell EMC Disk Array Enclosure
  - 5x146GB 10K rpm Fiber Channel-2
  - EMC software
- Dell Rack
- UPS
- LTO Tape Unit

## **Appendix C**

### **GIS Data Research and Collection**



USACE Sediment Master Plan  
GIS Data Collection Matrix

Category	Status	Description	Source	Date	Acquisition Method	Cost	Coverage	Gaps	Quality/Resolution	File Name	Size (MB)	Type	Projection	Datum	Units	FGDC	Metadata File Name
<b>Planning Level (statewide coastal datasets)</b>																	
Counties	USC - complete	Primary legal division of California	US Census Bureau	2000	download from website	free	Statewide			cacntys	0.6	poly	UTM 11	NAD83	Meters	no	cacntys_meta.html
Public Beaches	USC - data not available									data not available							
Erosion Hot Spots	USC - data not available									data not available							
Watershed Boundaries	USC - complete	California nested watershed version 2.2	CA Dept. of Forestry & Fire Protection	1999	download from website	free	Statewide			calw22	49.2	poly	Albers	NAD27	Meters	no	calw22meta.epi.html
Congressional Districts	USC - complete	California congressional district boundaries	CA State Senate		download from website	free	Statewide			cnsg_low	2.4	poly	UTM 11	NAD83	Meters	--	no metadata available
Roadways (for 20-ton trucks)	PB - complete	California highway network	Federal Highway Administration	2002	CD-NTAD 2002 (in-house)	free	Statewide major highway system	minor roads	1:100,000	nhpnlin_CA.shp (clipped from nhpnlin)	6.6	line	UTM 11	NAD83	Meters	yes	nhpnlin.txt
		California (Caltrans) State Highway routes	California Dept. of Transportation	2001	email from Caltrans	free	Statewide major highway system	less detail than FHWA coverage	1:100,000	st_hwy.shp	11.8	line	Albers	NAD83	Meters	no	st_hwy.shp.xml
Railways	PB - complete	California rail network	Federal Railroad Administration	2002	CD-NTAD 2002 (in-house)	free	Statewide		1:100,000	rail100k_CA.shp (clipped from rail100k)	2.5	line	GCS	NAD83	Degrees	yes	rail100k.txt; Rail100k_CA.shp.xml
Dams	USC - complete	California dam point locations	CA Dept. of Water Resources	1994	Melanie Coyne of CA Coastal Conservancy	free	Statewide			caldams	1.1	point	Albers	NAD27	Meters	yes	cadams_meta.txt
		California dam point locations	CA Dept. of Water Resources	2003	CD from C. Tracy, DWR	free	Statewide			CA_JurisdictionalDams.shp	3.6	point	GCS	NAD27	Degrees	yes	CAJurisdictionalDams.shp.xml
		National dam point locations	USACE, ASDSO, FEMA	1999	download from website	free	National			nid_ca.shp (clipped from nid.shp)	3.0	point	GCS	NAD27	Degrees	yes	nid_meta.html
Debris Basins	USC - complete	Southern California debris basin locations	CA Dept. of Water Resources	varies	Melanie Coyne of CA Coastal Conservancy	free	Ventura, Los Angeles, San Bernardino, Orange, and Riverside County			dbasins	0.6	point	Albers	NAD27	Meters	no	DBasin_metadata.doc
Littoral Cells	USC - complete	regions that encompass features affecting sediment transport	California Coastal Commission/Dept. of Boating and Waterways	2000	Melanie Coyne of CA Coastal Conservancy	free	CA Coast			litcells	0.5	poly	Albers	NAD27	Meters	yes	litcells.met.txt
Submarine Canyons	PB - complete	Coastal bathymetric contours	CA Dept. of Fish and Game	2000	download from website	free	CA Coast		50ft intervals out to 600m	nbath50f.shp	2.6	line	Albers	NAD27	Meters	no	nbath50f.txt
		Newport Bay bathymetric GRID	CA Dept. of Fish and Game	2002	download from website	free	Newport Bay, mouth, back bay		5 meter grid	newport	0.9	GRID	Albers	NAD27	Meters	no	bathy_readme.txt
		San Diego Bay bathymetric GRID	CA Dept. of Fish and Game	2002	download from website	free	La Jolla to Mexico, SD Bay, Mission Bay		5 meter grid	san_diego	8.2	GRID	Albers	NAD27	Meters	no	bathy_readme.txt
		Humboldt Bay bathymetric points	CA Dept. of Fish and Game	1998	download from website	free	Humboldt Bay	shows various points only	1 ft. depth intervals	hbath1fp.shp	0.1	point	Albers	NAD27	Meters	no	hbath1fp.txt
		SF Bay bathymetric contours	CA Dept. of Fish and Game	1997	download from website	free	San Francisco Bay		10m intervals	sfbath10m.shp	4.4	line	Albers	NAD27	Meters	no	sfbath10m.txt
		Tombales Bay bathymetric points	CA Dept. of Fish and Game	1997	download from website	free	Tombales Bay		1m depth intervals	tbath1mp.shp	3.0	point	Albers	NAD27	Meters	no	tbath1mp.txt
		Monterey Bay bathymetric DEM	National Ocean Service (NOAA)	1998	download from website	free	Monterey Bay		1 arc second (30m)	montereyb30	0.7	GRID*	UTM	NAD27	Meters	yes	DEM_75_Metadata.txt; fgdcbathy.pdf
		San Diego Bay bathymetric DEM	National Ocean Service (NOAA)	1998	download from website	free	San Diego Bay		1 arc second (30m)	sdiegeb30	0.7	GRID*	UTM	NAD27	Meters	yes	DEM_75_Metadata.txt; fgdcbathy.pdf
		SF Bay bathymetric DEM	National Ocean Service (NOAA)	1998	download from website	free	San Francisco Bay		1 arc second (30m)	sfranciscob30	0.7	GRID*	UTM	NAD27	Meters	yes	DEM_75_Metadata.txt; fgdcbathy.pdf
		Santa Monica Bay bathymetric DEM	National Ocean Service (NOAA)	1998	download from website	free	Santa Monica Bay		1 arc second (30m)	smonicab30	0.5	GRID*	UTM	NAD27	Meters	yes	DEM_75_Metadata.txt; fgdcbathy.pdf
		San Pedro Bay bathymetric DEM	National Ocean Service (NOAA)	1998	download from website	free	San Pedro Bay		1 arc second (30m)	spedrob30	0.1	GRID*	UTM	NAD27	Meters	yes	DEM_75_Metadata.txt; fgdcbathy.pdf
		Tombales Bay bathymetric DEM	National Ocean Service (NOAA)	1998	download from website	free	Tombales Bay		1 arc second (30m)	tombalesb30	0.1	GRID*	UTM	NAD27	Meters	yes	DEM_75_Metadata.txt; fgdcbathy.pdf
		LA-Orange Co. coast bathymetric GRID	US Geological Survey	2002	download from website	free	Santa Monica/Long Beach/Newport		16m grid	bathyg	120.0	GRID	UTM 11	WGS84	Meters	yes	bathygrd.txt
		Santa Monica Bay backscatter GRID	US Geological Survey	2002	download from website	free	Santa Monica Bay		16m grid	smmos	38.3	GRID	UTM 11	WGS84	Meters	yes	Multibeam Backscatter of... htm
		Long Beach Shelf backscatter GRID	US Geological Survey	2002	download from website	free	Long Beach Shelf		16m grid	lbmos	16.0	GRID	UTM 11	WGS84	Meters	yes	Multibeam Backscatter of... htm
		Newport Shelf backscatter GRID	US Geological Survey	2002	download from website	free	Newport Shelf		16m grid	npmos	75.6	GRID	UTM 11	WGS84	Meters	yes	Multibeam Backscatter of... htm
		San Diego Bay bathymetric GRID	US Geological Survey	1999	download from website	free	San Diego Bay		16m grid	sd_bathy	19.0	GRID	UTM 11	WGS84	Meters	yes	pacmaps.sd.xml/a-3-98-sc_fmata.htm
		San Diego Bay backscatter GRID	US Geological Survey	1999	download from website	free	San Diego Bay		16m grid	sd_back	19.0	GRID	UTM 11	WGS84	Meters	yes	pacmaps.sd.xml/a-3-98-sc_fmata.htm
		SF Bay bathymetric GRID	US Geological Survey	1999	download from website	free	San Francisco Bay		16m grid	sf_bathy	19.0	GRID	UTM 10	WGS84	Meters	yes	pacmaps.sf.xml/USGS Pacific Sea Floor
		SF Bay backscatter GRID	US Geological Survey	1999	download from website	free	San Francisco Bay		16m grid	sf_back	2.8	GRID	UTM 10	WGS84	Meters	yes	pacmaps.sf.xml/USGS Pacific Sea Floor
Navigation Structures	PB - complete	Electronic Navigational Charts data	National Ocean Service (NOAA)	2001	download from website	free	CA coastline	not all datasets for all regions	varies	about 1,660 files	230.0	point, line, poly	GCS	NAD83	Degrees	yes	metadata.txt
Coastal Wetlands	PB - complete	National Wetlands Inventory	US Fish & Wildlife Service	1981-	download from website	free	CA coast by 7.5' quad sheet	Mendocino to Bodega, Santa Cruz	varies	(quad_sheet)_p.shp (zipped)	84.2	poly	UTM 11	NAD83	Meters	yes	wetlands.html
		Vegetation - San Diego County	San Diego Assoc. of Govts. SANDAG	1995	download from website	free	San Diego County	Anza-Borrego SP, BLM, Indian lands	1:1200 to 1:24000	veg95.shp	65.2	poly	StatePlane VI	NAD83	Feet	no	SANDAG GIS - 1995 Vegetation Metadata.doc
Coastal Boundaries	PB - complete	Bays and Estuaries	CA Dept. of Fish and Game	??	download from website	free	Major bays and harbors along CA coast			bays_estuaries	0.3	line	Albers	NAD27	Meters	yes	bays_estuaries.shp.xml
		Coastal waters to 3 nautical miles	CA Dept. of Fish and Game	??	download from website	free	CA Coastline polygon		3-mile buffer of coastline	CA_cst3nm	0.9	poly	Albers	NAD27	Meters	yes	CA_cst3nm.shp.xml
USGS Topo Quad Sheets	PB - complete	Coastal bays/harbors and names	CA Dept. of Fish and Game	2002	download from website	free	Coastal bays and harbors			Coastal_bays_names	0.1	point	Albers	NAD27	Meters	yes	Coastal_bays_names.shp.xml
Hydrography	USC - complete	USGS topographic quadrangles	US Geological Survey	??	ESRI Data CD-ROM (in-house)	free	Statewide - all 1:24,000 quad sheets			topoq24_CA.shp (clipped from topoq24)	1.0	poly	GCS	NAD83	Degrees	yes	topoq24_CA.shp.xml
		California hydrological network	CA Spatial Information Library	1998	download from website	free	Statewide		1:100,000	hydro	117.0	line	Albers	NAD27	Meters	no	hydro.htm

<b>Macro Level (Ventura County)</b>																	
Shoreline Stabilization Structures	PB - data not available	see also Navigation Structures								data not available							
Controlled Aerial Imagery	USC - complete	Digital Ortho Quarter Quadrangles (DOQQ) Digital Ortho Quarter Quadrangles (DOQQ)	US Geological Survey US Geological Survey	1994 1994	download from website mosaicked in-house	free free	Countywide Countywide		3.75-minute (1 meter) 3.75-minute (1 meter)	282 files ventura_balance_24.ecw	13,300.0 594.0	TIFF TIFF	UTM UTM	NAD83 NAD83	Meters Meters	yes yes	{shapefile_name}.xml ventura_balance_24.xml
Coastal Wetlands - Vegetation	PB - complete	Vegetation - California	California Gap Analysis	1998	download from website	free	Statewide		50 meters	landcov.shp and associated DBF files	58.8	poly	Albers	Clarke1866	Meters	yes	CA-GAP Land-Cover Data Dictionary.doc
		Vegetation - California	CA Dept. of Forestry & Fire Protection	1997	CaSIL, ftp site	free	Statewide		1:250,000	vega.shp and associated DBF files	10.9	poly	GCS?	NAD27	Meters	no	vega.txt
		Vegetation - Calleguas watershed	AMEC/Ogden	2000	emailed from Co. of Ventura	free	Calleguas Creek Watershed	watershed only	1:12,000	cwveg.shp	14.0	poly	State Plane V	NAD83	Feet	no	cwveg_meta.doc
		Vegetation - Ventura River	Geo InSight Int'l Inc./DMEC	2002	emailed from Co. of Ventura	free	Ventura River Watershed	watershed only	1:1,000	Ventl_Wtrshd_hab.shp	3.3	poly	GCS	NAD27	Feet	yes	Metadata for Natural Veg...
		Vegetation - Calveg 1977	CA Dept. of Fish and Game	2000	coastal conservancy website	free	Santa Clara River Watershed	watershed only; more detail than Kuchler	1:1,000,000	sc_calveg.shp	0.4	poly	State Plane V	NAD83	Feet	yes	sc_calveg.html
		Wetlands - NLCD	USGS/ US EPA	2000	coastal conservancy website	free	Santa Clara River Watershed	woody wetlds/emergent herb. wetlds only	30 meter	sc_nlcdwet	0.2	poly	State Plane V	NAD83	Feet	yes	sc_nlcdwet.html
Grain Sizes	PB - complete	Farmland/Land Use	CA Dept. of Conservation	2000	download from website	free	Ventura County	northern (mountainous) part of county	1:24,000/1:130,000	ventura2000.shp	1.2	poly	Albers	NAD27	Meters	no	fmmp_meta.txt
		State Soil Geographic (STATSGO) for CA: soil textures	USDA, Natural Resources Conservation Service	1994	in-house dataset	free	Statewide		1:250,000?	soils.shp and associated DBF files	42.5	poly	Albers	NAD27	Meters	yes	State Soil Geographic metadata.doc
		Soil Survey Geographic (SSURGO) for Ventura County: soil textures	USDA, Natural Resources Conservation Service	2002	download from website	free	Ventura County	northern (mountainous) part of county		ca674_a.shp	22.9	poly	UTM 11	NAD83	Meters	yes	SSURGO metadata.doc
USGS DEM/DTM	USC - complete	sampled array of regularly spaced elevation values	US Geological Survey	2001	download from website	free	Countywide	none	varies from 10m and 30m	ventura_dem	84.8	GRID	UTM 11	NAD83	Meters	no	no metadata available
Land Use/Cover	USC - complete	Land use land cover classification data	US Geological Survey	1992	download from website	free	Statewide		30m	e.g. california_north.nlcd.tif.gz	154.0	Geo-TIFF	Albers	NAD83	Meters	yes	e.g. california_north_FGDC.txt
		C-Cap California 2000-Era Land Cover	NOAA	2003	download from website	free	California Coast		30m	ca_2000.img	72.7	raster dataset	Albers	NAD83	Meters	yes	ca_2000.met

planning level macro level total size	*converted from DEM
	912.3 MB
	14,359.7 MB
15,272.0 MB	

## **Appendix D**

### **Recommended Workstation Specifications**

Close



Dell recommends Microsoft® Windows® XP Professional

## Print Summary

Dell recommends Microsoft® Windows® XP Professional



OptiPlex SX260

\$1,624

Print

Catalog Number	Description	Product Code	SKU	Id
OptiPlex SX260 Ultra Small Form Factor:	Intel® Pentium® 4 Processor 2.40GHz, 533FSB, 512K Cache	2426U	[221-1612]	1
Operating System:	Microsoft® Windows® XP Professional, SP1, with Media and NTFS	XPP1EC	[420-2119]	11
Memory:	256MB DDR Non-ECC SDRAM (1 DIMM)	256N	[311-2177]	3
Internal Boot Hard Drive:	40GB EIDE, 9.5 MM, 5400 RPM	40	[340-7333]	8
Module Bay Devices:	24X Max, Slimline DVD-CDRW Combo Drive with Software Decode	24COMBO	[313-2125]	16
Embedded Video Board:	Integrated Intel® Extreme Graphics	INT	[320-0557]	6
Audio Solutions:	Integrated Sound Blaster Compatible	INT	[313-8170]	17
Keyboard:	Quietkey PS/2 Keyboard	PS2	[310-1515]	4
Monitor:	Dell UltraSharp™1504FPa flat panel (15.0viewable),HeightAdjustableStand	1504FPA	[320-2955]	5
Mouse:	Dell™ PS/2 2 button mouse	L	[310-1301]	12
Speakers:	DELL A425 SPEAKERS	A425	[313-2126]	18
Mouse Pad:	Mouse Pad	MPAD	[310-3559]	38
Floppy:	1.44MB 3.5 Inch Floppy Drive	3	[340-7335]	10
Network Adapter:	Integrated Intel Gigabit (10/100/1000), with Alert Standards Format	INT	[430-0410]	13
Resource CD:	Resources CD contains Diagnostics and Driver for Dell OptiPlex Systems	RCD	[313-7168]	21
Energy Star Setting:	Energy Star Enable	ES	[310-6413]	25
Hardware Support Services:	3Yr Ltd Warranty + 3Yr Same Day 4Hr On-Site Service (M-F 8am-6pm)	U3Y5X10	[900-6100] [900-6102]	29
Installation Support Services:	No Installation	NOINSTL	[900-9987]	32
Power				

Close



Dell recommends Microsoft® Windows® XP Professional

## Print Summary

Dell recommends Microsoft® Windows® XP Professional

Dell Precision Workstation  
650

\$5,722

Print

Catalog Number	Description	Product Code	SKU	Id
Dell Precision Workstation 650:	Intel® Xeon™ Processor, 3.20GHz, 1MB L3 Cache	65T321	[221-3838]	1
Operating System:	Microsoft® Windows® XP Professional, SP1 with Media and NTFS	WXP1	[420-1931]	11
Memory:	1GB,DDR266 SDRAM Memory,NECC (2 DIMMS)	1GN2	[311-2293]	3
First Hard Drive:	73GB Ultra 320 SCSI, 1 inch (15,000 rpm)	73S15	[340-8264]	8
CD-ROM, DVD, and Read-Write Devices:	8X DVD+RW/+R with Roxio® Easy CD Creator plus DVD decode	DVRWR8	[313-2147]	16
Graphics Cards:	nVidia, QuadroFX 1000, 128MB, dual monitor DVI or VGA capable	QXF1000	[320-0721]	6
Monitor:	Dell UltraSharp™1901FP flat panel(19.0 viewable),HeightAdjustableStand	1901FPH	[320-1576]	5
2nd Monitors:	Dell UltraSharp™1901FP flat panel(19.0 viewable),HeightAdjustableStand	1901FPH	[320-1576]	45
Keyboard:	Entry Level, PS/2, No Hot Keys	E	[310-1609]	4
Mouse:	Dell USB 2-Button Optical Mouse with Scroll	LOD	[310-4165]	12
Speakers:	Dell Two Piece Stereo System	A215	[313-2316]	18
Floppy Drive:	3.5 inch 1.44MB Floppy Drive	3	[340-3736]	10
Hardware Support Services:	3 Year Limited Warranty plus 3 Year NBD On-Site Service	U3YOS	[900-8710] [900-8712]	29
Installation Services:	No Installation	NOINSTL	[900-9987]	32

Print

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sn G29

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Dell recommends Microsoft® Windows® XP Professional

## Print Summary

Dell recommends Microsoft® Windows® XP Professional

Dell Precision Workstation  
650**\$4,293**[Print](#)

Catalog Number	Description	Product Code	SKU	Id
Dell Precision Workstation 650:	Intel® Xeon™ Processor, 3.20GHz, 1MB L3 Cache	65T321	[221-3838]	1
Operating System:	Microsoft® Windows® XP Professional, SP1 with Media and NTFS	WXP1	[420-1931]	11
Memory:	512MB,DDR266 SDRAM Memory,ECC (2 DIMMS)	512E2	[311-2279]	3
First Hard Drive:	73GB Ultra 320 SCSI, 1 inch (15,000 rpm)	73S15	[340-8264]	8
CD-ROM, DVD, and Read-Write Devices:	8X DVD+RW/+R with Roxio® Easy CD Creator plus DVD decode	DVRWR8	[313-2147]	16
Graphics Cards:	nVidia, QuadroFX 1000, 128MB, dual monitor DVI or VGA capable	QXF1000	[320-0721]	6
Monitor:	17 inch Dell (16.0 inch vis) M782 Flat Screen CRT Monitor	M782	[320-0173]	5
Keyboard:	Entry Level, PS/2, No Hot Keys	E	[310-1609]	4
Mouse:	Dell USB 2-Button Optical Mouse with Scroll	LOD	[310-4165]	12
Speakers:	Dell Two Piece Stereo System	A215	[313-2316]	18
Floppy Drive:	3.5 inch 1.44MB Floppy Drive	3	[340-3736]	10
Hardware Support Services:	3 Year Limited Warranty plus 3 Year NBD On-Site Service	U3YOS	[900-8710] [900-8712]	29
Installation Services:	No Installation	NOINSTL	[900-9987]	32

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## **Appendix E**

### **Recommended Server Specifications**

# Dell PowerEdge 2650 Server



Combining a new level of performance  
with availability and configuration  
flexibility in a space saving 2U chassis,  
the Dell™ PowerEdge™ 2650 delivers  
exceptional, cost-efficient computing  
power for a variety of front-end and  
mid-tier server workloads.

## Performance

The Dell PowerEdge 2650 server is architecturally balanced to maximize processing speeds as well as provide high data input/output (I/O) and memory bandwidth. Featuring dual Intel® Xeon™ processors with a 533MHz front side bus, the server is well suited for compute- and memory-intensive applications. Plus, it operates on the ServerWorks® Grand Champion-LE (GC-LE) chipset that provides an incredible 3.2GB/s of memory bandwidth and up to 3.4GB/s of throughput on a five PCI bus segment architecture.

The PowerEdge 2650 also incorporates new features such as high bandwidth PCI-X slots, dual Gigabit network interface cards (NICs) as well as high-speed double data rate (DDR) memory. In addition, the PowerEdge server offers an embedded dual channel Ultra3 (U160) SCSI controller that enables you to separate disk subsystems for different purposes on up to five internal SCSI drives. All of which help to improve speed and performance and maximize the capabilities of your server.

## Availability

Through a variety of availability features, the PowerEdge 2650 is designed to maximize server uptime. The server offers error-correcting code (ECC) SDRAM memory with ChipKill technology, and Spare Bank support to help withstand errors and avoid costly downtime. In addition, the general-purpose server features optional embedded Ultra3 (U160) RAID with 128MB of battery-backed cache that allows data to be written to a disk even in the event of power outage. Hot-plug SCSI hard drives, hot-plug redundant power supplies and hot-plug cooling fans, minimize the need to power the server down when fixing components. And the PowerEdge 2650 features dual embedded Gigabit NICs that provide failover support and help maximize I/O throughput.

## Configuration Flexibility and Expandability

The rack-optimized PowerEdge 2650 delivers a great balance of expandability and rack density. With three open PCI-X slots and numerous embedded features, you can deploy the PowerEdge 2650 in a configuration that supports a wide range of workloads in a data center. It provides SDRAM memory capabilities from 256MB up to 12GB to meet your requirements now and the six DIMM slots offer you the capacity to grow in the future. Plus, the chipset supports 2:1 memory interleaving for reduced memory latency. The split backplane design also offers configuration flexibility. For instance, you can configure two hard drives to mirror the operating system for redundancy and use the remaining three drives in a RAID 5 configuration for storing data.

Furthermore, its five hot-plug SCSI hard drives allow up to 730GB of internal storage. And three I/O slots expand functionality to beyond what is supported with the embedded feature set.

## Manageability and Serviceability

The PowerEdge 2650 incorporates special design features that make the server easy to deploy, service and manage remotely. It consists of a cable-less motherboard design that results in improved airflow for better temperature control and simplified serviceability. The tool-less chassis enables easy access to internal components for quick maintenance. In addition, the new Embedded Remote Access (ERA) management feature enables users to access, diagnose and remotely manage a server regardless of its state. The active, backlit Dell logo on the bezel and the front mounted LCD display are also designed to accelerate diagnosis and system repair through the use of light indicators and text messaging.

The PowerEdge 2650 full-featured server delivers exceptional performance, bandwidth and flexibility in a slim chassis to cost effectively manage a variety of front-end and mid-tier workloads.



PowerEdge 2650

Exceptional performance. Easy as **DELL**™

Visit [www.dell.com](http://www.dell.com) for more information.



# Dell PowerEdge 2650 Server

## DELL ENTERPRISE SERVICES

By leveraging the proven advantages of our direct model, including tailored service and support, low cost and a single point of accountability, Dell Services can provide you with fast, effective, affordable service offerings at any point in your IT process. By doing so, we offer a combination of bundled best practices and tailored solutions that work together to provide maximum value to you. Whether you need support, deployment, training and certification programs, or professional consulting services, individually or bundled as a total package, Dell promises to be your single point of accountability at all times.

### Professional Services

Dell Professional Services enables Dell customers to optimize ROI by leveraging complex technology through the design, development and deployment of innovative, robust and scalable business-critical solutions. With each engagement, we utilize our proven methodology and project management expertise to understand your business objectives, design plans that are flexible to adapt to your current environment and then deliver the desired results.

### Deployment Services

We bring you deployment assistance that delivers true value from beginning to end. Dell can tailor systems to our customers' specifications by customizing the hardware and software configuration during the initial system-build to reduce redundancy and time. We can manage the delivery, installation and disposal of your assets with the same eye for efficiency.

### Training and Certification Services

Our approach to Training and Certification allows you to outsmart your competitors - not outspend them - with industry standard learning across Dell hardware and industry standard software. Dell can assist you wherever you need us, whether on-site, on-line or in a classroom setting, to help your organization take full advantage of information technology.

### Enterprise Support Services

Technology is a significant investment, and it pays to have a partner who can help you minimize costly downtime. Through our Premier Enterprise Support Services (PESS) offerings, Dell provides tiered support service packages with the flexibility to customize the offering to meet your specific needs across a wide range of computing environments. With proactive and reactive support options which include hardware and software support with varied response levels, account management, and remote resolution, Dell provides support solutions that meet your needs, cost effectively.

Services vary by region. For more information on the available services in your area, please visit [www.dell.com](http://www.dell.com).

## FEATURES DESCRIPTION

<b>Form factor</b>	2U rack height
<b>Processor(s)</b>	Up to two Intel® Xeon™ processors at 2.0GHz, 2.4GHz, 2.8GHz and 3.06GHz with hyper-threading support
<b>Front side bus</b>	533MHz front side bus designed for fast data throughput
<b>L2 cache</b>	512KB advanced transfer cache designed to improve access time to server data
<b>Chipset</b>	ServerWorks® GC-LE Chipset supports five PCI buses: three PCI-X (1 x 64bit/133MHz, 2 x 64bit/100MHz), one 64bit/66MHz, one legacy bus (32bit/33MHz)
<b>Memory</b>	256MB - 12GB PC266 ECC DDR SDRAM Six DIMM sockets on system board configurable for Spare Bank support
<b>I/O channels</b>	Seven total: three full length PCI-X slots (1 x 64bit/133MHz and 2 x 64bit/100MHz), two embedded Gigabit NICs (64-bit/100MHz), and dual channel embedded Ultra3 (U160) SCSI/RAID controllers (64bit/66MHz)
<b>RAID controller</b>	Embedded dual channel Ultra3 (U160) SCSI with 128MB cache (enablement optional)
<b>Drive bays</b>	Hard drive bay for 5 x 1" or 2+3 hot-plug SCSI drives Media bay for one 24X IDE CD-ROM or 8X IDE DVD ROM, one 3.5" 1.44MB diskette drive
<b>Maximum internal storage</b>	730GB (5 x 146GB)
<b>Hard drives</b>	18GB, 36GB, 73GB, 146GB Ultra160 SCSI
<b>External storage</b>	SCSI and fibre channel storage systems
<b>Network interface card</b>	Two integrated Broadcom® Gigabit BaseT with load balancing and failover support
<b>Power Availability</b>	Optional, hot-plug, redundant 500W power supplies Spare Bank configurable ECC memory with ChipKill technology (512MB and 1GB DIMMs required) Dual channel embedded Ultra3 (U160) RAID with battery-backed cache Duplexing support Dual embedded NICs with failover and load balancing support Hot-plug redundant power supplies Hot-plug hard drives and cooling fans High availability fibre channel and SCSI cluster support Front mounted keyboard, video and monitor ports Embedded Remote Access (ERA) provides server management capability
<b>Graphics</b>	Integrated ATI-Rage XL controller with 8MB of SDRAM (not upgradable)
<b>Optional software</b>	Novell NetWare® Version 5.1; Novell NetWare Version 6.0 (supported, factory installation not available); Microsoft® Windows® Server 2003 Standard Edition; Microsoft Windows NT® Server 4.0; Microsoft Windows NT Server Enterprise Edition 4.0; Microsoft Windows NT Server TSE 4.0; Microsoft Windows 2000 Server; Microsoft Windows 2000 Advanced Server; Red Hat® Linux 7.1, Red Hat Linux 7.2, and Red Hat Linux 9
<b>Dimensions (H x W x D)</b>	3.375" x 19.0" x 27.5" (8.57cm x 48.26cm x 69.85cm)

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## Print Summary

PoweEdge 2650



\$10,525



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Catalog Number	Description	Product Code	SKU	Id
PowerEdge 2650:	PowerEdge 2650, Intel Xeon 3.06GHz, 512K Cache, 533MHz Front Side Bus	265305	[221-2655]	1
Additional Processors:	2nd Processor, Xeon, 3.06GHz, 512K Cache, 533MHz Front Side Bus	2P305	[311-2725]	2
Memory:	2.0GB DDR, 2X1GB DIMMS	2GB2D	[311-2735]	3
Chassis Configuration:	RapidRails for Dell Rack	RPDRAIL	[310-1482]	28
OPERATING SYSTEM:	Windows 2000 Server w/5 cal	W2KSVR	[310-1261][420-3663]	11
Hard Drive Configuration:	On-Board RAID 5, 3 to 5 drives connected to on-board RAID	MR5	[340-3946]	27
Hard Drive Backplane:	5 Bay (1x5) Hot Plug SCSI Hard Drive Backplane	1X5BKPL	[340-3932]	18
First Hard Drive:	146GB 10K RPM Ultra 320 SCSI Hard Drive	1461032	[340-7968]	8
Second Hard Drive:	146GB 10K RPM Ultra 320 SCSI Hard Drive	1461032	[340-7968]	23
Third Hard Drive:	146GB 10K RPM Ultra 320 SCSI Hard Drive	1461032	[340-7968]	54
Fourth Hard Drive:	146GB 10K RPM Ultra 320 SCSI Hard Drive	1461032	[340-7968]	51
Fifth Hard Drive:	146GB 10K RPM Ultra 320 SCSI Hard Drive	1461032	[340-7968]	52
Primary Controller:	PERC3-DI, 128MB Battery Backed Cache, 2 Internal Ch- Embedded RAID	ROMB128	[340-3943]	9
First Network Adapter:	Intel Pro 1000XT Gigabit NIC- Copper	IN1000T	[430-0375]	13
Second Network Adapter:	Intel Pro 1000XT Gigabit NIC- Copper	IN1000T	[430-0375]	48
CD ROM or DVD ROM:	24X IDE Internal CD ROM Drive	CD24X	[313-0317]	16
Diskette Drive:	1.44MB Diskette Drive	FD	[340-3961]	10
Monitor:	No Monitor Option	N	[320-0058]	5
Keyboard:	No Keyboard Option	N	[310-3281]	4
Mouse:	No Mouse Option	N	[310-0024]	12

Bezel:	Active Bezel Option for Dell PowerEdge 2650	BEZEL	[310-1487]	17
Cluster Status:	INFO,NO CLUSTER,STANDALONE	NOCLUS	[461-1306]	614
Power Supplies:	Redundant AC Power (2x500 Watt Power Supplies)	REDPWR	[310-4324]	36
Documentation:	Users Manual,Installation and Trouble Shooting Guide on CD	EDOCS	[310-1989]	21
Hardware Support Services:	3Yr GOLD Support, 4Hr Onsite, S/W Support, TAM Service	GOLD4U	[960-3029][960-4130][960-4132] [950-0117][950-0138][970-0237] [310-3785]	29
Installation Support Services:	No Installation	NOINSTL	[900-9997]	32

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**PowerVault 110T  
SDLT**

**\$6,246**



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Catalog Number	Description	Product Code	SKU	Id
PowerVault 110T SDLT:	PowerVault™ 110T, SDLT, 160/320GB, External Drive	SDLEXT	[221-2134]	1
Controller Card:	Cable Kit, Includes both VHDCI/68P and 68P/68P	CBLKIT	[310-1662]	9
Tape Backup Software:	TBU S/W VERITAS BUE Professional Suite	PSVEPRO	[420-2834]	25
Hardware Support Service:	3Yr BRONZE Support, Next Business Day Onsite	BRONZEU	[960-1305][960-1310][960-1312]	29
Installation Services:	PowerVault Installation Declined	NOINSTL	[900-9997]	32



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